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THE

JOURNAL OF SCIENCE.

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I. THE IDENTITY OF VITAL AND COSMICAL ENERGY.*

"The question of questions for mankind . . . is the ascertainment of the place which Man occupies in Nature, and of his relation to the Universe of things."—Prof. HUXLEY, *Evidence as to Man's Place in Nature.*

THE history of human thought is the history of two rival philosophies. Arrayed in various disguises, linked with widely differing methods of investigation and inference, sometimes appearing for a moment to meet and coalesce, but quickly starting back from the uncongenial embrace, Materialism and Idealism have for ages maintained a separate hostile existence. Yet no Materialist has succeeded in refuting the logic of Idealism, while every Idealist has practically assumed the real existence of Matter. Idealism has been in the position of a constitutional monarch, whose title is sure, but whose power is non-existent; while Materialism has resembled an irresponsible popular ruler, insecure yet all-powerful. But, if we cannot think without acknowledging one system, and cannot act without assuming the other, it will be wise to search for some logical bond of union between the two; and should we succeed in discovering actual unity beneath seeming disunion, the resulting synthesis may be entitled Hylo-Idealism, or the somatic *rationale* of the subjective and objective Universe. Here are the two main pillars which support the fabric of life and thought: let us see whether they do not

* Life and Mind on the Basis of Modern Medicine. By ROBERT LEWINS, M.D. London: Watts and Co.

rest on the same foundation. The little work before us may prove a valuable aid in the solution of this momentous problem.

In the present day no man possessing any acquaintance with the mechanism of the sensory organs can completely ignore the phenomenal or ideal theory. Its truths are forced upon him, whether he will or no; and at the end of his researches he is compelled to admit that his experiments upon those phenomena which he calls muscle and nerve have really been experiments upon varied modifications of his own consciousness. He finds that the nervous excitations which produce sensations so diverse as those of sight, hearing, taste, smell, and touch, are all essentially the same during their journey from the receptive organ to the brain. In every case a special apparatus receives a special impulse, which it transmits to a special region of the cerebrum; but the difference which exists between incident waves of light and sound, and impressions of touch, smell, and taste, is lost during transmission. When the motion thus propagated arrives at its terminus in the encephalon, it excites the sensation peculiar to that group of nerve-cells which is affected; but the mode of vibration which was communicated to eye or ear is not necessarily reproduced, and can obviously have nothing in common with the subjective phenomenon. "Supposing that the nerves of hearing and of sight of a man were cut, and the peripheric end of the former were perfectly united with the central end of the latter, and contrariwise that the peripheric end of the nerve of sight were perfectly united with the central end of the nerve of hearing, then the sound of an orchestra would elicit in us the sensation of light and colour, and the sight of a highly-coloured picture would elicit in us impressions of sound. The sensations which we receive from outward impressions are therefore not dependent on the nature of those impressions, but on the nature of our nerve-cells. We feel not that which acts on our bodies, but only that which goes on in our brain."* Idealism is thus irrevocably established; yet we must warn the opponents of Materialism not to indulge in premature exultation. All knowledge is derived from phenomena; but the existence of an independent proplasm or matrix of phenomena is not therefore disproved; and if it be a necessary postulate, without which both psychical and physical science are empty delusions, we must accept this unknown Matter as the basis of our ideal

* Muscles and Nerves, by Dr. J. ROSENTHAL, p. 283.

Cosmos. That this is the case has been shown in a previous paper,* where it is argued that this primary truth is involved in the assumed validity of reason and experience. Science has led us to Idealism; we are therefore bound to listen to the testimony of Science in support of the rival theorem.

The scientific diviner of past and future can, in the nineteenth century, scarcely be an absolute sceptic. What is really meant by the geologist who deciphers the unwritten records of a period when Earth was literally "without form and void," since there was no eye to receive the rays of light and transmute them into form and colour; by the astronomer who reveals the secrets of Heaven in ages yet more remote, and sees in imagination that molten and swiftly rotating terrestrial mass which could never have been an actually present phenomenon to the brain of man or beast? Phenomenal existence is in both cases clearly out of the question; for we cannot suppose that elaborate theories of cosmical and organic evolution depend on the hypothetical assumption of an Infinite Mind, in which is formed a continuous and eternal picture of the material universe. Evidently both astronomer and geologist mean to imply that Matter existed long before any known mind, and that the reality of its existence is in no way affected by the presence or absence of a percipient. The science and art of Medicine are founded upon the same postulate. Every physician is certain that the conscious or unconscious body upon which he exerts his skill is something more than a spectral figment of his own imagination; for by its means he hopes to evolve Cosmos from Chaos in the subjective universe of his patient. He knows that muscles, nerves, and skeleton owe that visible and tangible conformation which he perceives to the creative power of his own organs of sense; but he does not assume the arrogant *rôle* of sole and unconditional Creator. When he leaves the bedside the phenomena which were formed in his brain will disappear; the unperceived and independent reality will still remain. The very operation of his drugs is secret, but none the less sure.

It is therefore needless to insist further upon the real existence of Matter, which is taken for granted by all sane and practical men. But it may be doubted whether this simple postulate affords sufficient foundation for a consistent theory of life and mind, unless supplemented by the invocation of some super-sensuous and super-ideal entity. Is that which we call Mind an independent spiritual substance, or

* "Animal Automatism," by C. N., in the Journal of Science, April, 1882.

is it simply the outcome of certain changes in the grey matter of the encephalon? Here, when we remember the "sensifacient" power of our sensory ganglia, there seems but small ground for dispute; yet we may as well see whether the advocates of Dualism can produce any reasonable argument in support of their heresy. We will take as our text the main thesis enunciated by Dr. Lewins, viz., "the all-sufficiency of Matter to carry on its own operations, and the consequent non-necessity of a vital or spiritual principle as an entity apart from the inherent energy of the material organism," and we will examine the evidence which may be adduced for and against such a thesis.

The old *à priori* argument, that Matter, being essentially inert, cannot originate force, falls to the ground before the discoveries of modern Physics and Physiology. It is, indeed, founded upon two baseless assumptions, one of which is sufficiently refuted by Newton's formula of Universal Gravitation, and the other by modern anatomical investigations and reasonings from the observed effect of stimulants, &c., and of cerebral disease or injury.

The first fallacy, or the doctrine of inertia, has long ceased to be an article of scientific faith, and is relegated to a limbo peopled with such ghosts as the phlogiston theory and Nature's horror of a vacuum. Newton's first law of motion, the very proposition chiefly relied upon as expressing and formulating this lack of automatic energy, really goes to prove that motion is a condition of matter not less natural than rest.* A body completely isolated for all eternity in a boundless vacuum would either remain at rest for ever or would move uniformly in a straight line. Either event would be equally natural; for the origin of equilibrium stands in quite as much need of explanation as the origin of movement. The former may, indeed, be represented as the resultant of two or more opposing and equally balanced forces, or, in the words of Sir John Herschel, as "a continual production of two opposite effects, each undoing at every instant what the other has done." The latest theories respecting the constitution of matter require us to regard every molecule not merely as attracting, and thus moving or holding firm other molecules, but as itself in a continuous state of vibratory or rotatory agitation. Cohesion therefore represents a condition not of rest, but of intense activity.

* Newton's mystical statement in his letters to Dr. Bentley—"It is inconceivable that inanimate brute matter should, *without the mediation of something else which is not material*, operate on other matter"—is a proposition virtually *unthinkable*.

Could any material particle suffer a momentary loss of energy the seemingly passive mass of which it formed a part would become visibly active, and the forces hitherto counterbalanced would immediately assert themselves. Yet this increase of apparent action would be the effect of a decrease in real power. It appears, then, that force or energy is an inalienable attribute of matter, and that the momentary suspension of this *vis insita* in any part of the universe must necessarily result in a world-destroying catastrophe. But as cosmic energy is inseparable from the material cosmos, we have obviously no right to invoke a spiritual agent for its production, unless we are prepared to isolate other properties, such as impenetrability and extension, and to place each under the charge of a special Archæus.

Our external Universe is, however, if not inert, at least for the most part unconscious. How can this deaf and blind and senseless dust ever bud into even the lowest form of mind, far less blossom into the ideal glories of the philosopher and the poet? This objection loses its weight when we remember that the real problem to be solved is not—Can Matter think? but—Does Matter think? We reason on an entirely false method when we seek to invalidate conclusions derived from observation of living organisms merely because observation of inorganic matter does not yield all the data upon which such theories are founded. A particle of dust possesses various sensible qualities. It affects our senses of touch and sight in a special manner; it attracts and is attracted by other particles. But the several kinds of energy which it exerts give us no *à priori* reason to believe that some or all of its constituents will at any future time be recombined in a living and thinking brain-cell; nor will our closest examination suffice to discover any sign of such a destiny. Now statements such as this, not unfrequently dwelt upon by Dualists, are distinguished by perfect truth, but also by perfect irrelevance. We can only convince ourselves that Matter can think, by the observation of thinking matter. To infer that a nerve cannot feel because a straw is insensate, is as absurd as to conclude that, since ice makes us feel cold, boiling water cannot make us feel hot. In both cases there is a graduated scale between the two extremes, represented in the latter by a regularly intensified heat-quiver, in the former by a slowly increasing complexity of organisation, from which are at length evolved the first faint and doubtful rudiments of consciousness.

It seems now scarcely necessary to do more than mention the second fallacy with which we have to deal. This is

involved in the idea that the vital energy manifested in what are called spontaneous acts is independent of any antecedent cause. A non-vital body, it is said, never moves except in consequence of some impulse communicated from without. Even though its separate particles be unresting, the entire mass needs some external stimulus to disturb its equilibrium. But this is not less true of organic and living matter, whose motions invariably depend upon external stimuli, although the connection is not apparent to a merely superficial observer. A person who had never seen a clock wound up, or who had not learnt to associate the process of winding with its usual results, might imagine that ticking and striking were spontaneous actions, solely dependent on the will and pleasure of the timepiece. In the same way, a person wholly unacquainted with physiology fails to connect the functions of nutrition and respiration with the functions of thought, sensation, and voluntary motion. Yet it is not more certain that a clock will stop if not wound up, than that the human mechanism will cease to work if not supplied with food and fresh air. Even an action which seems perfectly free and uncaused is the last term of a succession of internal changes which had their beginning in some impulse from without. When the impulse is spent the changes will cease. But the functions of the clock depend on its original structure not less than on the periodical winding up. From one point of view every tick may be regarded as due to the tools and hand of the clock-maker; from another, to the key which winds it up once a week. In the same way, the energy which displays itself in perception and volition may be ascribed to the daily transubstantiation of food, drink, and oxygen; or it may be traced in imagination to the pre-natal period, or even followed yet farther back through a long line of slowly-developed ancestral forms. From any point of view the influences concerned in its production or evolution have been purely somatic.

Just as the forces which operate in a living cell cannot be essentially different from those which sustain the entire body, so the identity of vital and cosmical energy is conclusively proved by the constant interchange of matter—and consequently of material force—which takes place between that body and its environment. Man is to the circumambient world as a blood-corpuscle to the organism of which it forms a part. It possesses no vitality distinct from that of its Cosmos, the body, where its life as an individual cell begins and ends; yet it moves with apparent freedom, giving and receiving nutriment, and (in the case of the white corpuscles)

exhibiting independent contractile power. The alchemist and charlatan Paracelsus taught that Man is a complete homologue of the Universe, and that all the celestial and terrestrial motions are repeated in the narrow compass of his corporeal frame. What is true of the little inner world, he argued, must therefore be true of the great outer world, so that Microcosm and Macrocosm mutually explain each other. This mystical doctrine, springing from a false theory of physics, and productive of innumerable absurdities, yet contains a seed of truth. Man is indeed an integral part of cosmic physiology.

Many will readily allow that what is called "animal life" needs no spiritual entity for its production and support, but will hesitate to assign a material origin to our intellectual and moral faculties. Yet it has been proved by experiment that an appreciable amount of heat is evolved by cerebral, just as by muscular, action; so that were our instruments sufficiently delicate, and our estimation of mental effort sufficiently exact, it would be possible to assign an equivalent in units of heat to every expenditure of intellectual force. This shows that thought is not less intimately connected with modifications of cerebral tissue than motion with modifications of muscular fibre. Thought is indeed the result of that slow combustion set up in the grey matter of the encephalon by the capillary circulation of blood from the lungs, just as contractility is the result of combustion in the muscles, and secretion of combustion in the liver and other glands. Not only does the vital machinery stop if the circulation in the brain be suspended, but its action can be temporarily restored after apparent death by injections of oxygenated blood. The head of a dog separated from the trunk has been thus for a moment revivified, so that when the animal was called by name its eyes turned in the direction of the familar sound.*

Life, like cohesion, is thus proved to depend upon a special adjustment of material forces. When one of these is disturbed, equilibrium is lost; and if this disturbance can be rectified, equilibrium is regained. It is well pointed out by Dr. Lewins that the ancient *rationale* of "suspended animation" is practically inconsistent with the efficacy of those "mechanical means of treatment successfully employed for the restoration of the apparently dead. Where matter is held to be essentially inert, a vital principle, an animating spirit, *must* be assumed, which in syncope,

* The Brain and its Functions, by Dr. J. Luys, p. 69.

asphyxia, or death, deserts—either temporarily or finally—its material tenement, to emigrate as an indestructible, veritable entity elsewhere." * Now since we can, under certain circumstances, restore life by the re-establishment of its material conditions, it is evident that we have to deal not with a spiritual entity, but with a delicate and easily deranged mechanism. It is true that if too long a time is allowed to elapse before restorative measures are applied, the repair of the machine becomes impossible; but this arises from the intimate relation of its minute and complicated parts. Every change in the organism sets up a multitude of other changes, which progress so quickly that the whole soon becomes irreparably disintegrated.

Anatomical and clinical observations in cases of mental disease, as well as experiments upon the living brain of the lower animals, point to the same conclusion. In the article by Drs. Tuke and Gibson, in the ninth edition of the "Encyclopædia Britannica," Insanity is described as "a chronic disease of the brain, inducing chronic disordered mental symptoms,"—a definition possessing "the great practical advantage of keeping before the student the primary fact that insanity is the result of disease of the brain, that it is not a mere immaterial disorder of the intellect." That barbarous treatment of the insane which still lingered in England and France during the early part of the present century is closely connected with the ancient doctrine of demoniac possession; and so long as Dualism continued to influence scientific practice, it is obvious that no efficient or systematic remedial measures could be adopted. The alienist medicine of Ancient Greece and Egypt, like that of our own time, was founded upon a materialistic basis: and we are but just awaking from the cruel mediæval dream to that light of day which was discerned—clearly, though far less brightly—by Hippocrates and Galen.

Mental pathology is now in a position to take vengeance for its long neglect by laying bare those morbid physical conditions which give birth to the mystical hallucinations of apostles, martyrs, prophets, and founders of Religions. We may fairly contend that all recorded celestial visitations "belong to the very alphabet of medical science, and may be confidently diagnosed as not preternatural occurrences at all, but merely symptoms of over-excitement—the result either of anæmia or hyperæmia—of the nervous centres in the head. Just as demoniacal possession is manifestly

* Life and Mind, p. 20.

merely a disordered condition of the organism, so are Divine possession, inspiration, prophetic fury, and such phantasmata as Belshazzar's vision, and the apocalyptic sights and sounds of seers and second-sight wizards of every race and clime, from Ezekiel to Merlin, from Daniel to Thomas the Rhymer." The whole host of heaven and hell may be engendered by abnormal condition of the blood-vessels, or their contents, which supply the sensory ganglia, and by consequent morbid excitation of the cerebral hemispheres. A sunstroke or an epileptic paroxysm may be the immediate cause of a throng of supernatural sublimities and horrors, which will mould the destiny not only of the seer himself during his brief span of life, but of half the world for more than eighteen centuries.

Facts such as these, which cannot be seriously disputed by any practical alienist, should prevent men of Science from coquetting with animistic fallacies. Yet even so accurate an observer as Sir William Gull, who, in his recent article on Vivisection,† repudiates the exploded theory of "a mysterious vital force," and declares that "our corporeal life is but the operation of material atoms and material forces within the reach of experimental enquiry," cannot refrain from the inconsistent assertion, in a later part of his apology, when defending Medicine from the charge of Atheism, that "Science has to do with that which is external to us," and that "what lies beyond or beneath is relegated to other tests and to other evidence, of which it may be said that they afford more certainty than even Science can give us." Now since our "corporeal life" really includes our intellectual life, these "material forces" cannot be considered as "external" to us. If Science has to do with these, and with the mental phenomena which depend upon their operation, it embraces the whole sphere of consciousness, leaving nothing "beyond or beneath" to which any preter-scientific tests can possibly be applied.

The practical conclusions drawn by Dr. Lewins must command the assent of all who have acknowledged the validity of his premises. Since the belief in "immortality" (in the usual sense of the word) is inconsistent with materialistic views, it is plain that if Heaven is not for ever to remain an idle dream its delights must be realised on Earth. Perfect health is synonymous with perfect holiness,—

* Life and Mind, p. 23.

† See note at the end of "Animal Automatism," in the April number of Journal of Science.

the two terms being etymologically one,—and consists in the harmonious development of every bodily organ. This is not to be misunderstood as a glorification of sensuality, or as an exaltation of muscle above mind; for the cerebral fount of intellect and morality will share in the common well-being, and will remain the lord of life, and the creator of that Paradise which is enjoyed by all the members.* Self-denial, or even Self-sacrifice, is not excluded from the list of virtues and blessedness; for in the exercise of such supreme moral qualities is the very essence of supreme personal and social happiness and well-being. Undue self-indulgence is forbidden by Science, and enlightened egotism itself as "fatal to that harmony of organic function on which true beatitude depends." This is surely no unworthy or incomplete ideal; and though our age seems at present far from this Kingdom of Heaven, it is the duty of each of us to labour earnestly for its realisation, and thus ensure its final epiphany. If this consummation can only be effected by a cataclysm which will overwhelm the present fabric of society, and destroy that boasted high-pressure civilisation and inhuman competition of which money-getting commerce and luxury are the chief end and aim, and misapplied Science the chief gauge of "progress,"†—that civilisation in which "the individual withers" and whose characteristic human products are narrowed down and specialised to that precise organisation which is best fitted for the making of a pin's head or the dissection of a moth's wing,—we must accept the inevitable "Decline and Fall" which History shows to have overtaken all our predecessors in the paths of Empire, —not without humiliation, not without self-reproach,—yet with trust in the better future of Humanity unchecked and boundless.

CONSTANCE ARDEN (C. N.).

* See a tract by Prof. DU BOIS-REYMOND, of Berlin, "Ueber die Uebung," ably reviewed in the Journal of Science for March last.

† See, on this subject, Mr. Frederick Harrison's eloquent Lecture at the London Institution, in the April "Fortnightly Review," entitled "The Nineteenth Century."

II. THE ASSOCIATION FOR THE ADVANCEMENT OF MEDICINE BY RESEARCH: ITS TASK AND ITS OPPONENTS.*

THE medical profession and no small part of the scientific world have now for years endured the foulest, the most outrageous calumnies, and the grossest misrepresentations. The object of their assailants has been to render physiological research practically an impossibility. For in these days it must surely be admitted that any natural science which is deprived of the power of experimentation, and compelled to depend upon the mere observation of accidentally occurring phenomena, is in bondage, and cannot advance. These attempts—unfortunately too successful—have been conducted with a wonderful amount of energy and persistence, and with a remarkable degree of unscrupulousness. Money has been freely given, tracts have been scattered broadcast, advertisements have appeared in the political and literary press, at railway-stations, and on hoardings. Lectures have been delivered, and meetings have been held under pretence of discussion. In fact all the elaborate machinery of political agitation has been put, and kept in action. We may here ask how it is that the art of resisting and opposing "movements"—as they are called—has not been more carefully studied?

Medical men and non-medical biologists have meantime practically kept silence. They have, indeed, replied ably and triumphantly to the calumnies of their assailants; but these replies have appeared merely in professional and scientific journals which do not fall into the hands of the outside world. The leaders of the agitation, the "honorary" secretaries, &c., no doubt studied these replies, but very judiciously passed them over in silence. Hence the lay public, hearing the charges and meeting with no defence, fell into the not unnatural mistake of supposing that none had been offered, or was even possible. It was supposed that the

* Reports of the Meeting at the College of Physicians.

Vivisection Scientifically and Ethically Considered in Prize Essays. By J. MACAULAY, M.D., Rev. BREWIN GRANT, B.A., and A. WALL, L.R.C.P. Edinburgh. London: Japp and Co.

The British Medical Association and the Vivisection Bill. By A. DE NOE WALKER, M.D. London: M. Walbrook.

accused were letting judgment go by default, and thus a very widespread and active prejudice—we will not call it opinion—was created against biological experimentation.

There was another misfortune: the attacks were made by organised bodies, whilst the resistance was carried on by individuals. This was a twofold evil. Not the most illustrious name—be it even that of Richard Owen or Charles Darwin—carries as much weight as does a society. What is of even greater importance, no private individual had at his disposal the funds for issuing advertisements, handbills, and posters in reply to the slanders issued by the enemies of research. Physicians, professors, editors of learned journals, &c., have not time to range about canvassing for signatures to petitions. Hence the contest—if contest it can be called—was utterly unequal, and public ignorance was fully aroused and organised. Then came legislative action. The Vivisection Bill became law, and even this did not convince scientific men of the necessity of prompt, energetic, and united action. On the contrary, there was a widespread belief that with the passing of this measure our enemies would be satisfied. An esteemed medical contemporary even considered that the Act would not "in any material way" hinder the progress of research, and that it would "calm the needless apprehensions and put an end to the odious misrepresentations which have been recently rife concerning this subject, and which have been in ignorance adopted by persons of consideration who will probably in future take more pains to be correctly informed." Never did a forecast more signally fail. The agitation grew more furious, the misrepresentations waxed grosser; Bills were repeatedly brought in for completely abolishing vivisection under any circumstances whatever, and, if they have been hitherto rejected, what security have we for the future? All these onslaughts and menaces, however, did not rouse those concerned to action, and it was not till the outrageous prosecution of Prof. Ferrier that this most ill-advised apathy came to an end. Rumours have since then been circulated that something would shortly be done. What that something might be was concealed, perhaps judiciously, from the friendly portion of the press. At last it has been laid before friends and enemies alike, and the questions naturally arise whether what is to be done is the right and the sufficient thing? Let us, in the first place, express our pleasure that the protective movement was supported not merely by medical men and biologists, but by men eminent in other departments of Science, by clergymen, lawyers, and statesmen,—

men who are not personally engaged in physiological experimentation, but who recognise its importance and its necessity. But if we carefully examine the proceedings and sift the speeches delivered our satisfaction is not enhanced. The very title of the proposed society falls short of our expectations. It is organised for the "Advancement of *Medicine* by Research." Now there is much biological research needed, at present in abeyance in this country, which has no direct bearing upon medicine, and which very conceivably may never throw any light upon the healing art. Let us take as instances the investigations in which Dr. Blake has used the physiological action of metals as evidence bearing upon their atomic weights. Or we may mention all those researches in which animals are exposed to higher or lower temperatures, greater or less degrees of atmospheric pressure, different colours or intensities of light, varying hygroscopic conditions, &c. Such experiments certainly do not involve any "section" at all. But we are by no means certain that, given a foolish magistrate and able unscrupulous counsel, they might not be construed as infringements of the Act. Now researches of this class are of the highest importance as respects the origin of species, but their bearings upon medicine are very problematic. Will the proposed Association protect men engaged in such investigations? On a careful consideration of the speeches delivered, we see no clear evidence in the affirmative. Says Sir William Jenner, in his presidential speech, "Besides medicine it [the Association] would take in research in therapeutics, the effect on the human frame of some gases, foul air, and other things which rendered it susceptible to disease." In moving the formation of the proposed Association he is reported to have used these words:—"That with the view of bringing the legitimate influence of the medical profession to bear on the promotion of those exact researches in physiology, pathology, and therapeutics which are essential to sound progress in the healing art, an Association be formed, to be called the Association for the Advancement of Medicine by Research." Now on weighing these words, and on examining the utterances of the other eminent men who took part in the proceedings, we are reluctantly led to the conclusion that experimentation for purely biological purposes, independent of medical applications, is left out in the cold. This is the more to be regretted, since the anti-vivisectionist fanatics are quite astute enough to see the importance of drawing a distinction in their attacks between the medical profession and non-medical biologists. They are, in the first place,

anxious to crush the latter. We are sorry to see the faculty falling into the trap, and thus, apparently at least, abandoning their allies.

We turn to another phase of the subject. Sir W. Jenner is reported to have said—"There was no desire on the part of those who had worked in the formation of that Association to evade the law; there was no desire on their part to ask for a repeal of the law, or even for any modification of it."

If these were the words really uttered—and uttered, as it seems, without any qualification on the part of the speaker himself or of others—we scarcely see that the Association has any well-marked *raison d'être*. This law which is to exist unattacked is the only tangible hindrance or danger against which physiologists require to be "protected." Let us for a moment consider the meaning of Sir W. Jenner's words. If the promoters of the Association do not desire a repeal, or even a modification, of the Vivisection Act, they admit it substantially as justifiable and necessary! By so doing, as seems to us, they condone the agitation which led to the passing of the Act and all its consequences, even to the indignities which medical Science has suffered in the person of Prof. Ferrier. We can easily conceive the rejoicings with which this speech and these admissions will be received in anti-vivisectionist circles. They will very naturally be accepted as evidence that the defenders of physiological experimentation either feel doubts as to the goodness of their own cause, or lack the energy and the courage needed for its defence. And as a necessary result the enemy will take heart and redouble their exertions to deprive physiologists of the last fragments and shadows of liberty which they still possess. Anti-vivisectionists have all along urged that the physiologists—unlike chemists, physicists, astronomers—"need watching." Now it will be said that they confess such necessity!

What is perhaps even more to be regretted, eminent men of Science and the leaders of the medical profession, if they accept the lines on which the Association is to be founded, accept at the same time all the illogicalities of which the Vivisection Act is so conspicuous an embodiment. According to this Act the higher and purer the motive the more culpable the deed. The man who skins a living frog and sprinkles it with salt for a wager escapes the censure of the law; so does the angler who impales a frog upon a hook as a bait for jack, and leaves it to writhe for an entire night; so does the youth who drenches a newt with petroleum and sets it on

fire. But if anyone inflicts upon an animal one tithe of such torment for the sake of discovery he is liable to a penalty of £50, and, in addition, possibly to imprisonment. Yet, in spite of such absurdities and inconsistencies, Sir W. Jenner tells us that he and those who are acting with him do not even ask for a modification of the law! It might not be possible at the present moment, and while public opinion remains in its present morbid condition, to obtain a repeal of the law, or even for any substantial amendments. But public opinion, which has been industriously infected and corrupted by persons whom we may designate as social disease-germs, may under judicious treatment recover. Now to promote such recovery is, we are glad to find, one of the objects of the Association. Sir James Paget stated, very truly, "The Society to be formed would address itself to the really intelligent portion of the public, and enlighten them on the subject of medical science." This is very well; the public—even the respectable and intelligent portion of it, prelates and peers of the realm not excepted—are grossly ignorant on the subject of medical science. To enlighten them would be well, but what purpose would this enlightenment serve if it is not to pave the way to a repeal of the Act? Misrepresentations and sophisms have been the seed of the Act; public ignorance the soil in which it flourished. Can we seek to destroy those seeds and that soil with any other purpose than to ensure the withering of the evil crop?

We find Sir Risdon Bennet moving that "the Council shall take note of and seek to remove any hindrance which may appear to them to be operating adversely to the progress of medical knowledge." What is the "hindrance" save the Act in question?

There are some further peculiarities about the proposed Association which seem of doubtful expedience. There is no fixed subscription, "but members of the Association are invited to give such aid as they may desire to the general purposes of the Association, or towards special expenses incurred." This arrangement seems scarcely judicious, since, if the Council mean real business, funds must be regularly and abundantly forthcoming. To enlighten the public is a costly undertaking.

Again, if we do not misinterpret the reports of the proceedings, the membership of the Association is open, with the exception of some few official personages, to medical men only. Sir James Paget proposed "That registered medical men desirous of promoting the above objects shall,

with the consent of the Council, be admitted as members of the Association on the nomination of an ordinary or corresponding member of the Council." We do not see it stated that other persons are eligible. Of course medical men, as the most numerous class directly concerned, must naturally take a predominating part in such a body. But we should have thought it judicious to accept support from whatever quarter it might be offered. The anti-vivisectionists have no restrictions on membership.

Having thus noted, we trust fairly, what the Association proposes to do, we may be permitted to glance briefly at what it overlooks and ignores. We should have expected that one of the very earliest steps taken by such a body would have been a solemn and dignified, but uncompromising denunciation of the Anti-Vivisection movement in all its manifestations,—in which denunciation all medical and scientific bodies, faculties, colleges, &c., would be urged to take part. We say "all scientific societies," and not merely such as occupy themselves specially with biology or natural history. Such is the solidarity of the sciences that a blow aimed at any will more or less be felt by all. Such a unanimous censure could not fail to carry great weight with the reflecting portion of the public.

Another step which might be useful, and to which we find no allusion in the programme of the new Association, is the formal refutation of the various writings, pamphlets, bills, and advertisements issued by the enemy. This is something supplementary to the mere general "enlightening the public."

A further useful move would be to obtain the names of all avowed Anti-Vivisectionists who are notoriously addicted to "sports" and other pursuits involving the infliction of pain and death upon animals, or who in their writings and speeches have shown themselves indifferent to human or animal suffering. A list like the following would be instructive:—

The Right Hon. A. B.	*Angler.*
The Earl of C. D.	*Courser.*
The Duke of E. F.	*Battue-sportsman and Hurlingham hero.*

Another point aimed at might be organised opposition to open and avowed anti-vivisectionists at all elections—parliamentary, municipal, &c. Let those gentlemen who are continually introducing into the House of Commons Bills

for the further restriction of research know that, when next they appear before a constituency, the vote and influence of all medical and scientific men, irrespective of party, will be given against them. Similar steps ought to be taken as regards appointments to professorships, to medical offices, and as regards the membership of learned societies. The anti-vivisectionists have long since employed these or similar weapons against the friends of biological research. One of their stratagems, however, we do not recommend to be turned against them. We mean anonymous letters. Our enemies have freely made use of this cowardly means of annoying gentlemen supposed to be engaged in physiological research, or known as its defenders. Indeed the loud demands for the names of those to whom licenses for experimentation have been granted find here their explanation. The appeals for publicity mean "Give us the names of these men that we may try to instil prejudices into the minds of their patients!" Of such weapons Science cannot stoop to avail herself. But in other respects the war must be "to the utterance."

A further important point should be to obtain the opinion of the most eminent Counsel upon the Act. No one who is engaged in the study of animal life at all knows exactly when and where he is safe. This should be ascertained as clearly as possible. It is said that there is no Act of Parliament through which legal skill is not able to drive a coach and four.

Sir William Jenner, indeed, formally disclaimed any desire to "evade the Law." On this head opinions differ. Regarding the Law as a barrier to the progress of Science, we should pronounce any practicable evasion not merely justifiable, but laudable. The anti-vaccinationists and the "Peculiar People" are carrying their points by this very stratagem of evading, and even defying, the Law.

Looking seriously and calmly at the entire position, we cannot help regarding the formation of the Association for the Advancement of Medical Science as unsatisfactory. Fanatics, we submit, can only be routed if encountered with a resolution as uncompromising as their own.

For the thorough-going friends of Science there are, as it appears to us, two courses open: we may retire from the struggle in disgust, and hope that perhaps some unforeseen change may alter the present deplorable position; or, as there are several societies for attacking research, may there not be two, at least, for its defence? Suppose that a Biological Research Defence League is formed, open to all men,

and pledged to adopt all conceivable agencies for the defeat of the Anti-Vivisectionist Agitation, and ultimately for the total and unconditional repeal of the obnoxious law!

(Gentlemen favourable to the establishment of such a League are invited to communicate with the Editor of this Journal.)

III. ON THE SENSE OF SMELL IN INSECTS.

By J. W. SLATER.

IT is generally admitted that in insects the sense of smell reaches a power and a delicacy to which we find no comparison in other departments of the animal kingdom. Not only our unaided senses, but our scientific methods of research, are in comparison gross and ineffective. Our most skilful chemists tell us, for instance, that saccharose when duly refined is one and the same whether it be obtained from the sugar-cane or from the beet-root. But if we place the two side by side near a bee-hive, these little creatures soon show their perception of a difference by settling upon the cane-sugar, and leaving its northern bounty-defended rival untouched. Whilst, however, we so unanimously recognise the consummate olfactory power of insects, there has been a great lack of accord as to its seat. The antennæ, the palpi, the orifices of the tracheæ or respiratory apparatus, have all been declared to be the representative of the nose in Mammalia. Recently another view has been most ably advocated by Dr. Wolff, on the faith of certain delicate anatomical researches. This investigator has discovered a peculiarly differentiated tract in the soft membrane extending from the palate to the labrum, richly supplied with nerves, provided with certain parts which he regards as olfactory rods, and with a flask-shaped gland which appears to secrete a kind of mucus, serving to keep the above-mentioned membrane moist.

Whilst, however, there can be little doubt that the membrane in question subserves some especial function, and is probably an organ of sensation, there is, as it appears to me, no serious evidence derived from observation or experiment

that the part in question is the seat of the sense of smell. On the other hand, not merely constructive but direct evidence is accumulating to show that this sense in insects has its seat in the antennæ. This evidence I will here endeavour as briefly as possible to unfold.

We will first give a short examination of the antennæ in the leading insect groups, noting particularly in what forms they are most highly developed. We find them, firstly, larger and more complicated—

In the males than in the females.
In adult insects than in larvæ.
In nocturnal species than in their nearest diurnal allies.
In groups possessing a relatively low degree of activity than in such as are remarkably swift on the wing.
In species which depend upon one kind of nutriment only as compared with such as are multivorous or omnivorous.
In species which are relatively large than in minute forms, which pass their whole career amidst a superabundance of nourishment.
In forms which lead an independent existence at least in the mature state, or in parasites which change their host rather than in true Epizoa which infest one and the same animal from birth to death.
In species where the development of the eyes is moderate rather than in those where it reaches a maximum.
In terrestrial species rather than in the aquatic.

A few instances will make these differences of development more intelligible.

The sexual distinction is exceedingly striking. In no case, as far as I am aware, are the antennæ of the male smaller and simpler than those of the female, whilst in a multitude of forms there is a well-marked excess in the opposite direction. This is very notably the case in the Lamellicorn beetles (e.g., *Melolontha fullo*), in certain nocturnal Lepidoptera, genera *Bombyx, Euthemonia, Arctia, Liparis, Orgyia, Odonestris, Saturnia,* &c. We meet with the same distinction in certain Diptera, where the antennæ of the male are beautiful plumes,* whilst those of the female are simply bristles.

Throughout the entire insect-world the antennæ of the

* To the naked eye: much of this grace disappears if they are strongly magnified.

larva, whether it resembles the mature insect in shape or not, are minute and simple. Indeed careless observers take an incredulous look if they hear mention of the antennæ of a caterpillar.

The distinction between diurnal and nocturnal species is often very plainly marked. If we take the most typically diurnal beetles, the tiger-beetles, the Harpalidæ, the Buprestidæ, the majority of the Elateridæ, we find the antennæ made up of linear portions like threads or bristles. Of the forms which have clavate, flabellate, or pectinate antennæ, a large part are nocturnal. Among Lepidoptera the case is very similar. The plumed antennæ, so common among the night-flying moths, are quite unknown among their diurnal kindred, the butterflies.

Of all insects those possessing the greatest locomotive power are probably the dragonflies. Here, accordingly, we find the antennæ very short and simple, never having more than eight joints, and being attenuated instead of enlarged at the tip. On the other hand, great complication of structure is met with in groups which are slow on foot, which take wing with difficulty, and do not steer well when flying, —all which attributes are well marked in the great family of Lamellicornes.

Of omnivorous insects we may take the common house-fly as a type. Scarcely any kind of organic matter comes amiss to its latitudinarian tastes, and here accordingly we find antennæ of three joints only. With such forms we may usefully contrast the carrion-beetles which do not ordinarily make use of any other kind of food, and whose antennæ all terminate in a jointed club, formed as if of a number of flat plates laid one over another, and, though joined together at their centres, yet detached round the circumference so as to expose a large surface to the air and the action of fumes and odours. Again, we may take the enormous family of Curculionidæ. Almost every species of this multitude is restricted for its food to a single plant or to a group of closely-allied forms, and here accordingly we see the antennæ always terminating in a club.

Of the simplicity of these organs in Epizoa the fleas and lice are a good instance. On the other hand, the Ichneumonidæ—which, though parasitic in their earlier stages, have, when mature, to lead an active life, and to search out an appropriate habitation for their young—have very long and highly-developed antennæ.

As an instance where the evolution of the eyes is complementary to that of the antennæ, we may take the same

groups which we brought forward in speaking of locomotive power. In the dragonflies, and in the true flies, or Muscidæ, the eyes are as remarkable for their size and efficiency as are the antennæ for their minuteness and simplicity of structure.

To show the higher development of the antennæ in terrestrial than in aquatic groups, we need merely compare the Dytiscidæ with the Carabidæ, both similar in their diet and in their rapacious character.

Let us now ask ourselves what meaning underlies these structural differences in various forms? We cannot look upon the antennæ as mere ornamental appendages, like the crests, trains, and tufts met with in so many birds. Their ample supply of nerves characterises them at once as organs having some important function to fulfil. We glance first at their higher development in the mature insect than in the larva, and in the male as compared with the female of the same species. We know that of all the senses that of smell is most closely connected with sexual relations. Even in the human species it is comparatively in abeyance until the age of puberty. The indifference of young children to odours, pleasant or offensive, has often been noticed. It is by this sense in most animal species that the two sexes are attracted to each other; and as it is almost invariably the part of the male to take the initiative and seek up the female, he requires the more powerful and sensitive olfactory organs. If we take those genera of nocturnal Lepidoptera above mentioned, such as *Saturnia*, &c., where the antennæ of the male are so much more complicated than those of the female, we shall find two important points:—

a. The male is active in habit and possesses developed wings, whilst the female is in all cases sluggish and sedentary, often remaining at or near the spot where she has issued from the pupa. In many cases she is even practically wingless.

b. The male actually does follow the female by scent. This is proved by a host of observations made by insect-hunters in the practice of sembling. Male moths will come from a considerable distance straight to a virgin female enclosed in a box. To controvert the plea that such males are attracted by some sound supposed to be emitted by the female, but inaudible to human ears, it has been found that they will hover over and settle on any object upon which a virgin female has been sitting, or the empty cocoon from which she

has crept. All these phenomena are rationally explicable if the antennæ are the organs of scent. They are utterly unintelligible if we suppose them to be organs of hearing or touch. On the other hand, it has not been shown that Dr. Wolff's organ has any exceptional development in the males of *Saturnia*, &c., either as compared with their respective females or with other species where the locomotive powers of the sexes are nearly equal, and where consequently the males require no exceptional faculties for seeking their mates.

We take the next case,—the relatively greater development of the antennæ in nocturnal groups, with which we may couple the inverse perfection of these organs as compared with the eyes. It will be admitted that if the antennæ are the organs of smell, this difference is precisely what might be expected. Species whose sight is exceptionally acute and powerful, and who in addition, like the dragonfly and the house-fly, are swift and enduring on the wing, have relatively little need of complicated scent organs. Conversely those which are slow in their walk and flight, such as the clumsy dung-beetles, and whose eyes are in comparison small or less advantageously situate, require an acute scent to compensate for the deficiency. It is very doubtful whether an enemy or a booty to be captured could approach a dragonfly from above, below, or behind without being detected. But, *e.g.*, the Dynastidæ may be approached from behind, from above, and to some extent from the sides, without coming within their range of vision. Here, therefore, especial delicacy of scent must be needed, or must at least be beneficial to such species as possess it. It may, then, be fairly submitted that the nicety of the sense which they need will be causally connected with the organs which in them are so signally developed.

We turn next to the distinction between the monophagous and the polyphagous groups and species. It can require no formal demonstration that the former must require more accurate means of seeking their nutriment than the latter. The blowfly, which loves carrion, but which in case of need does not object to the nectar of flowers, the juices of fruits, and the excreta of animals, is in little danger of starvation, and its sense of smell does not require to be finely discriminating. On the other hand, the sexton-beetle (*Necrophorus*), which feeds on small carrion, and nothing else; the *Geotrupes*, which preys on the excreta of the herbivorous animals,

and nothing else; the rose-beetle, which consumes merely the nectar and the pollen of a few species of flowers—all require an organ of scent not merely acute, but nicely discriminating. Accordingly we find them endowed with highly complicated antennæ. Similar observations, which might be worked out to a greater extent than space here permits, all point in the same direction. We have therefore a case which falls under the method of "concomitant variations." We have evidence that a certain faculty varies in different insect groups. We see, further, that the development of a certain organ varies in a manner which may be pronounced parallel with the variation of the faculty. We are therefore, I submit, warranted in forming the provisional conclusion that the organ in question is the seat of the faculty in question.

I will now consider some of the objections urged against the olfactory character of the antennæ. It is maintained that a scent-organ must be placed in connection with the respiratory apparatus, so that a current of air laden with odoriferous particles may be drawn over its surfaces. This condition is essential, it appears to me, only when the organ in question is placed in the interior of the animal. An olfactory membrane placed in some deep cavity in the body, and not traversable by a stream of air, would be simply useless. But place the organ externally, where it freely encounters the atmospheric currents, and can if needful be waved backwards and forwards in the air, and this objection falls to the ground. Nor does the dryness of the antennæ seem a fatal objection. The entire body of insects is much drier than that of vertebrate animals or mollusks.

There are those who maintain that the antennæ are organs of touch. To this I reply that their excessive shortness in some species, and their delicate texture in others, renders them unsuitable for this function. In other species they are undoubtedly used as "feelers." But we must remember that in many Mammalia the nose serves this double function—*e.g.*, in the horse, the pig, and the elephant.

That they can be organs of hearing may be, I think, regarded as discredited by the considerations already brought forward, as well as by the fact that indisputable ears have been discovered in other parts of certain insects; those especially in which the faculty of hearing is most plainly present have their ears in the first abdominal ring just above the joint of the hind legs, and others in the tibiæ of the fore legs.

An argument in favour of the antennæ being the seat of

scent must not be omitted: they can be readily applied to or turned towards objects to be examined, and this in a discriminating manner. Dr. Wolff's organ, on the contrary, does not admit of being specially applied to minute objects or thrust into crevices, as is done by, *e.g.*, the ichneumons in their search for latent larvæ or pupæ.

We now come to the conclusive test of direct experiment. For this purpose I have selected certain lamellicorn beetles. These insects, if suitably fed, can live for a considerable time in captivity, and, if not roughly handled or startled by sudden and abrupt movements, they show a certain degree of docility —I might even say of attachment. My first observations of this kind were made, many years ago, upon a very large male stag-beetle which lived in my vivarium for about a year.* If I took him out and set him upon a table he would travel about with the leaflets of his antennæ shut. If I held out a piece of pear or apple he would immediately advance his antennæ, open the leaflets, and march straight towards the desirable morsel. When it was laid down for him to eat he always passed his antennæ over it, just as a dog smells at any food given him. Having thus satisfied himself of the suitable quality of the food, he began to eat. With moistened brown sugar he behaved in a similar manner.

I have since made similar experiments with common dung-beetles (*Geotrupes*). If these insects were placed under a glass bell they remained quiet, or roamed listlessly about with their antennæ contracted, and the leaflets of the club closed. If a portion of excrement was then introduced the beetles became attentive, moved the antennæ about, opened the leaflets of the club, moved towards the dung, and examined it by applying the antennæ just as did the stag-beetle with the slices of fruit.

Similar experiments were made at different times with many specimens of the rose-beetle (*Cetonia aurata*). On offering these beautiful insects sugar or flowers—such as whitethorn or elder blossom—their behaviour was precisely the same as that of the stag- and the dung-beetles under similar circumstances.

Insects which do not possess club-formed or lamellate antennæ are less suitable for such experiments, as the very characteristic phenomenon—the expanding the leaflets or plates of the club—is necessarily wanting. But even species possessing simple antennæ behave in a similar manner.

* After his regretted death he was transferred to my collection of Coleoptera, and measures 3⅜ inches from the tip of the jaws to the posterior end of the elytra.

Thus I have repeatedly seen a *Carabus monilis* in my vivarium examine a small worm or caterpillar by moving his antennæ over it, without actually touching the prey. Specimens of *Vanessa urticæ* have made quite analogous movements on being regaled with moist sugar, and *V. atalanta* behaves in precisely the same way if presented with its favourite food—a piece of an over-ripe plum.

On the other hand, if any substance possessing a repulsive odour—*e.g.*, a fragment of carbonate of ammonia, or a lump of camphor, &c.—is placed in the track of an insect, I have observed the antennæ, if previously stretched forward, to be suddenly withdrawn and closed, just as we, on encountering an offensive odour, turn away our head and close or cover the nostrils.

These simple facts, which anyone who is so disposed may with little trouble witness for himself, seem to me to carry very great weight. We know that insects as a class possess the sense of smell in a very high degree of development. We know, further, that almost all animals endowed with this sense examine their food by smelling. Surely, then, we may conclude that those organs which insects apply to, or rather wave over, their food, and which are thrown into a state of evident excitement on the approach of any odoriferous article, must be the seat of the sense of smell. To suppose an animal examining its food by listening seems utterly absurd.

Other observers have gone much farther than I have done, and have reached substantially the same conclusion. Thus Le Père Montrousier, of New Caledonia ("Annual Record of Science and Industry," 1877), coated a weevil (*Octhorrhinus cruciatus*) completely over with wax, save the tips or clubs of the antennæ. On presenting to it oil of turpentine, which is an abomination to most insects, it showed strong marks of uneasiness, and endeavoured to escape. Another specimen of the same species had merely the tips of its antennæ coated with wax, and it remained perfectly indifferent to all strong-smelling substances. This pair of experiments must, according to the canons of inductive reasoning, be accepted as conclusive, and indeed form a good experimental instance of the application of the "method of difference." In the first case the fumes of the turpentine are absolutely cut off from every part of the body save the club of the antennæ; yet they are perceived by the insect, and recognised as a nuisance. In the second case the clubs alone are protected, and scents are no longer recognised. We are surely therefore warranted in the definite conclusion that the

club of the antennæ is in insects the seat of the sense of smell. But the researches of Le Père Montrousier are confirmed by those of another observer. Dr. Gustav Hansen ("Zeitschrift für Wissenschaftliche Zoologie," xxxiv., p. 367) has studied the behaviour of insects towards strongly odoriferous bodies, both in the natural state and after the antennæ have been removed or coated with paraffin. In either of the latter conditions they ceased to recognise smells. Blowflies thus treated took no notice of tainted meat.

The conclusion may therefore be accepted as irresistible that the antennæ, and in particular their terminal portion, are the organs of smell. The internal organs, so minutely studied by Dr. Wolff, may indeed be organs of some sense, —possibly of one unknown to man,—but there is no evidence that they are in any way concerned with the perception and appreciation of odours. The assertion, on the other hand, of Dr. Vitus Graber ("Die Insekten," p. 305), that "no one has yet proved that the antennæ of insects evince any sensibility for odoriferous matters," will, in view of the direct evidence to the contrary given above, be permitted to find its own level.

IV. THE HIGHEST EDUCATION AND ITS DIFFICULTIES.*

HAVE we in reality reformed our Universities and their teachings so as to bring them into real harmony with the position and the wants of the age? Professor Huxley in one of the works before us seems to reply in the affirmative. He tells us that the Recommendations of the Commission, of which he was an active member, have been well nigh anticipated by the spontaneous action

* University Reform. The Inaugural Address for 1881. Delivered at Canterbury College, New Zealand University. By Prof. A. W. Bickerton, Christchurch, (N.Z.) Tombs and Co.

Science and Culture. By T. H. Huxley, F.R.S. London: Macmillan and Co.

Oxford University Examination Papers. Second Public Examination. Honour School of Natural Science. Trinity Term, 1879. Michaelmas Term, 1879. Trinity Term, 1880. Michaelmas Term, 1880. Oxford: Clarendon Press.

of the Universities themselves. To what extent and from what point of view is this actually the case? We see in fact that splendid laboratories, fitted with every modern appliance for research, have been created. We find that chemistry, physics, biology, &c., are receiving some amount of recognition even though greeted with such contemptuous bye-names as the study of "stinks and bones." But in introducing new studies do we not still pursue them too much in the old manner? We teach say, Biology, but as something to be examined in, rather than as something to make discoveries in. The laboratories which have been so munificently founded, and in some cases even endowed, have not begun to pour forth even the first tricklings of a stream of researches such as flow from Berlin, Munich, Strassburg, even from Kasan and Perm. It has been well said that if the mediæval scholastics had possessed Newton's "Principia," or Darwin's "Origin of Species," they would have simply treated it as they did the writings of Aristoteles—made it the foundation of an infinity of verbal subtleties and quibbles. Just so we; give us what new subjects you please we simply misapply them.

Again the University reform spoken of is found wanting at the very outset. The man who enters an English University is still treated on the Procrustean principle. No matter what may be his especial powers, his tastes, his ultimate objects, there is imposed upon him one common course. So long as this uniformity is demanded from all alike, so long, we venture to say, will the English Universities be poor in original research. Very similar in their spirit are the remarks of Prof. Bickerton and the eminent authorities whom he quotes. All agree that our Universities are someting quite different from what we might reasonably expect, from what the honour and welfare of the nation demand, and it may be added, from what their founders and benefactors originally intended. Thus the Rev. Mark Pattison, Rector of Lincoln College, Oxford, declares "the colleges were in their origin endowments not for the elements of a general liberal education, but for the prolonged study of special and professional faculties of men of riper age."

Mr. Pattison again complains that the "colleges have become boarding schools in which the elements of the learned languages are taught to youths." The present condition of things he pronounces "nothing less than a state of national destitution and intellectual blight." Matthew Arnold, after declaring that it is the function of the University to develope into science the knowledge a boy brings

with him from school, adds that "our English Universities do not perform the function of a University, as that function is above laid down." Professor Seeley, of Cambridge, writes: "The present insignificance of our Universities in the work of science explains itself very naturally by the system pursued in them." A Cambridge private tutor is quoted as saying, "If so-and-so did not think so much he might do very well." Thus we see that the "reform," so far, is only in appearance. Oxford and Cambridge men as well as those who have studied at German Universities, men of science, men of letters, and men of the world, alike tell us that our system is fundamentally bad, and that it is exercising an injurious effect upon the whole of secondary education.

As one of the causes of the disease, for it is nothing else, Prof. Bickerton justly, in our opinion, points out the undue cultivation of verbal memory which has so long ruled in the schools. "The successful schoolboy is often an unsuccessful man, because the glib word memory, that makes the thousand and one inflictions of the Greek verb an easy task, is not the chief requisite in the more important problems of after life." The author gives us from his own experience as science lecturer at Winchester College a very important observation which we do not recollect having met with before. "The junior classes exhibited distinctly more reasoning faculty than the elder ones. In many cases I have had the clearest evidence that mere memory work distinctly reduced the capacity for consecutive reasoning." Need we then wonder that so many boys who enter our public schools bright and intelligent come out as vapid dolts?

We must now turn for illustration of what has been said to the Oxford examination papers now before us, which, from many points of view, may prove instructive.

We have already rehearsed the well known truth that the exclusive attention formerly given at the old English universities to classics and mathematics no longer exists. The Natural Sciences are taught, and that by no means superficially. But are they taught fairly? There are two fundamentally distinct ways of ascertaining the proficiency and the capabilities of a student. We may either test to what extent he has succeeded in absorbing and assimilating the discoveries of others, or we may ask what are his powers of original research—of adding, in some department or other, to the sum total of exact, systematised human knowledge. These two methods do not

invariably coincide in their results. The man who has the most original and suggestive mind, who is the best observer of phenomena, and the most happy in detecting their laws, is not always the one who can most easily retain in his memory and reproduce in the form of answers to questions the substance of approved text-books. There is a further distinction to be drawn. We may say to the student at his very matriculation in the words of Mephistopheles, "Waehlt euch eine Facultät," or we may enforce upon all comers, whatever their ultimated estination, one common course. In other words, we may seek to train either specialists or "good men all round." Thus we have, in fact, four different roads open, each in itself simple enough but difficult to combine together. It is scarcely legitimate to require from the student a remembrance, at once general and minute, of the whole scope of modern science, and at the same time to lay before him questions which, to be fairly answered, call for some amount of original research. It is injudicious and inequitable to oblige a man to distribute his time and attention among a great variety of subjects, and then expect him to show, in each or in any one, the knowledge of the specialist, who has made it the sole task of his life.

We turn, from personal predilection, to the questions set in Biology, and we cannot help noticing much that comes in collision with the views we have just set forth. We at once admit that the examinations in question are a reality and not a sham. No amount of mere verbal memory, even if aided by the utmost resources of "crammers" and "coaches," would here avail. Manipulative skill is tested; the student is called upon to identify specimens laid before him, to give a reason for embracing this or that theory, and on some points even to produce views of his own. This is so far highly satisfactory, though the question may be raised whether either the individual student or science itself is benefited by forcing into him at high pressure such an amount of learning in so brief a time. What is thus hurriedly bolted will hardly be assimilated. But after a careful inspection of the questions, their number, their scope, and their nature, we are forced to the conclusion that those for the Michaelmas Term, 1879, and the Trinity Term, 1880, are unreasonable under the conditions of the case. We will suppose that an Oxford man goes in for biology. His previous knowledge of the science will, in nineteen cases out of twenty, neither be extensive nor perhaps very accurate. Too often he will have something to unlearn. On entering college he will first have to pass Responsions and Classical

Moderations, which will occupy him to the end of his first year. After this he is required to pass an examination in physics and chemistry, in which a practical knowledge is demanded. Few can acquire this knowledge without working for two terms in the laboratory. The student, therefore, who intends offering himself for examination for honours in Biology has only two years and two terms remaining! Whether these requirements are judicious is not here the question. So long as they are upheld by the authorities of the University it is obviously the duty of examiners to draw up their papers accordingly. Surely it is unfair to expect young men, after so brief a study of so vast and complicated a subject, to deal with such questions as the following:—"Examine critically the statement that there is less difference between the structure of man and that of the anthropoid apes than there is between that of one of an anthropoid ape and the lowest existing simiæ." "Discuss the affinities of the Characeæ to the Red Sea-weeds." Give an account of the phenomena to which the term 'Reflex Action' was applied by the Physiologist who first used it. What explanations had been previously given of the same phenomena? In what respects has the application of the term been extended by writers of authority during the last twenty or thirty years? In what sense is it now most frequently used? Could any other, in your judgment, be conveniently substituted for it?"

"Comment on the following passages from Harvey's second letter to Riolan (passages quoted), in which he states his opinion as to the way in which the right auricle of the heart fills with blood. Give an historical account of the steps by which the knowledge we at present possess on this subject has been acquired." "What are the various types of structure observed in secreting-cells? Give examples and diagrams." "What are the microscopic characters of the contractile tissues of the higher plants?"

"Give some account of the earliest researches in anatomy carried on within the University of Oxford." "Trace from its earliest discovery the influence of the microscope, simple and compound, upon the progress of biological science."

"Write essays on any two of the following subjects * * * * The reciprocal adaptation of plants and insects. Putrefaction and other fermentative processes in relation to Bacteria. Segmentation or the repetition of similar parts in plants and animals. The definition of life."

We may surely say, that to do full justice to some of these questions and subjects, special original research is needed;

or to put it in the mildest form, careful undisturbed thought. Can a student, limited as to time and disturbed by the anxiety which most men feel when passing an examination, be fairly expected to deal with matters still open to doubt?

It is further to be noticed that in order to answer some of the questions the candidate must have been familiar with *recent* numbers of Prof. E. Ray Lankester's journal, the "Quarterly Journal of Microscopic Science." As instances may be quoted the following:—"Give an account of the fertilisation and early growth of the ovule of a flowering plant and compare the structures concerned with their homologues in Gymnosperms and Pteridophyta."

"Give a classification of the Medusæ and their related polyp-forms. Criticise the recent attempts to establish two groups of Medusæ by reference either to the characters of the nervous system, or, on the other hand, to those presented by the ovaries and spermaries."

"What is the mode of origin of the vertebrate red blood-corpuscule during embryonic and in adult life? What facts may be adduced from the histology of Invertebrata, which tend to throw light upon the origin and significance of hæmoglobine-coloured corpuscles?"

Could either teachers or students expect that questions would be set upon matter only just published at the time of the examination?

We thing it will be further admitted that great and sudden changes in the character of an examination, unless duly announced as impending for some considerable time beforehand, such as a year, are radically unfair. Yet such a change is most palpable in the examination papers before us. Those for Trinity Term, 1879, Dr. Pye-Smith (M.D., London) being then the examiner, are exceedingly fair—sufficiently difficult to exclude the incompetent, yet at the same time not going beyond what may be reasonably demanded from candidates whose time and opportunities for preparation are such as have been described. The practical knowledge of the students is duly tested in making microscopic preparations and dissections, as well as in naming numbered specimens of animals and plants, but no questions are asked demanding anything approaching to original research. W may here state parenthetically our opinion that when such research is required, the subjects ought to be either selected by the student himself, or otherwise should be given a couple of terms beforehand. To return to the examination papers. Those for Michaelmas Term, 1879, Prof. E. Ray Lankester and Dr. J. Burdon-Sanderson being now the examiners,

show a completely different character, as we have already explained at some length. This character is maintained and even intensified in the papers for Trinity Term, 1880. It is right here to observe that Prof. Ray Lankester, being himself an Oxford man and having taught biology in that university, cannot be ignorant of what could under the circumstances be fairly expected from the students. It has been said that genius adulterates philosophy. Might it not, in a somewhat similar spirit, be urged that a man may be too learned, too able to examine average young men? It is important to note that the papers for Michaelmas Term, 1880, show a different character, much more like that of the papers set by Dr. Pye Smith. This return to more moderate demands upon candidates is perhaps due to the fact that certain teachers of biology in the university, without making any attack upon the examiners, memorialised the Board of Studies on the extreme difficulties besetting the study of the science under the existing conditions. It is difficult to formulate any absolute rule to prevent in future any such perturbations of the career of students as that we have just been describing. In a science which is growing so rapidly and undergoing such important changes as biology, it is not easy to select a set of text-books and decree that the answers to the questions propounded must be contained in these works and these only. Something must naturally be left to the discretion—not the indiscretion—of examiners. Between a list of questions which form no test of proficiency and another which might puzzle men of established reputation if required to be answered on the spur of the moment, lies a golden mean not too narrow nor hard to discover.

One final reflection may be allowed us. Suppose a student, who has passed such severe examinations as those for Michaelmas Term, 1879, and Trinity Term, 1880, were to become a candidate for an appointment in a museum. Would he be bound to undergo the "preliminary" scrutiny usual in "open competitive examinations?" Would his proficiency in orthography be tested by requiring him to write down a quantity of matter dictated or rather gabbled over by a "familiar" of the Civil Service Commission blessed with a questionable pronunciation and with an enunciation beneath all question?

V. A NEW FACTOR IN ORGANIC DEVELOPMENT.*

IT is now, we think, generally admitted, even by the most orthodox Darwinians, that natural selection does not suffice to explain the origin of all the features of the animal and vegetable kingdoms. It has been repeatedly shown in the *Journal of Science* as well as elsewhere, that the principle laid down by Darwin and Wallace, though it may account for the preservation of any favourable variation, throws no light at all on the origin of variation. To the question why did not the first protozoon launched upon the earth not simply reproduce its like *in secula seculorum* it can return no answer. A further difficulty is the explanation of the minute and exact purposiveness so often recognised in the animal organism. Here Natural Selection, even aided by Sexual Selection, is plainly inadequate. Here, consequently, the advocates of individual, or, so to speak, "mechanical" creation take their stand, and ask us to show how such an apparent adaptation of means to ends can have arisen? This problem has not newly arisen. Empedocles† dealt with it of old (one of the interesting proofs of what Greek philosophy might have been and done but for the great aberration mainly due to Socrates, Plato, and their following) and sought to explain purposiveness upon purely mechanical principles without the introduction of teleological considerations. With him as with Dr. Roux, "the purposive is not a something intended, but something which has come to pass; nothing teleological, but something natural; not that which corresponds to a pre-conceived plan, but that which had the properties necessary for existence, surviving." It may be scarcely necessary to add that this view is opposed not merely to the idea of individual creation but to that of Evolution‡ upon certain given lines. We must further note

* Der Kampf der Theile im Organismus Ein Beitrag zur Vervollstandigung der Mechanischen Zweckmässigkeits lehre. Von Dr. W. ROUX. Leipzig: Engelmann.

† Empedoclis Agrigentini fragmenta disposuit, &c. H. STEIN. Bonn, 1852. P. 4.

‡ Why may we not, as some Americans have done, substitute for Evolution the plain English word "Unfolding?"

that the principle of the struggle for existence, which is of course merely Natural Selection viewed from a slighty different stand-point, was first propounded by Heraclitus, with whom conflict, strife was the author of all things.

It must be admitted that Lamarck's principle, the action of use and disuse, furnishes a more direct explanation of the purposive than does Natural Selection. This principle has scarcely been sufficiently appreciated and followed out. Experimental evidence is wanting as to how far the modifications produced by use or disuse are hereditary. It seems to us, also, that many authors who admit that a muscle, an eye, &c., can be strengthened and improved by use, or, on the other hand, more or less completely atrophied by disuse, have overlooked the truth to which Prof. Du Bois-Reymond draws attention in a memorable discourse lately reviewed in the *Journal of Science* (1882, p. 165). The increase in bulk of a muscle as occasioned by regular exercise, and, conversely, its diminution if allowed to remain inactive, cannot fail to modify the nervous centres. We are thus brought to the principle which Dr. Roux discusses at length in the work before us. There is not merely a struggle for existence—a conflict between species and species, or between individuals of the same species. There is also a struggle within the organism itself, a conflict between molecules, between cells, between tissues, and between organs. By this conflict, intimately connected as it is with the Lamarckian principle of use and disuse, much of the adaptation, the purposiveness observed in the animal system becomes intelligible. Before considering more closely this internal conflict, which may, perhaps, be likened to the "competition" which in a community takes place between individuals, classes, interests, &c., we may return for a moment to the Lamarckian principle. This principle has been more fully recognised by Haeckel than by Darwin. The former considers that if *e.g.* the wings of domestic poultry have not been reduced to a mere rudimentary state, the cause must be sought in the insufficient number of generations which have elapsed since these birds were brought under human influence and in the circumstance that with them the struggle for existence is not very intense, so that the principle of "organic economy" does not come into play. Darwin, in his work on the "Variation of Animals and Plants under Domestication," lays a greater weight on the effects of use and disuse than he does in the "Origin of Species." Dr. Roux, after noting the somewhat perfunctory manner in which this question

has hitherto been dealt with, proposes the following law of functional adaptation:—"With increased activity every organ increases merely in that dimension (or those dimensions) which subserve the augmented activity. Thus a muscle, which by increasing use may reach twofold its former thickness, does not gain appreciably in length. Thus functional hypertrophy does not occasion growth in all dimensions but in one or two only, and thus gives to a limb or to an entire animal new morphological characters. This transforming agency is facilitated, quantitatively supported, and complicated by its antithesis, the atrophy of inactivity, which is also subject to the same dimensional laws. But in order that these two principles may lead to transformations, permanent causes, which compel increased use or disuse, are necessary, and if the changes produced are to become hereditary, such causes must continue for generations. Dr. Roux also discusses the effects of a qualitative functional adaptation, without which the animal organism would remain on the stage which it has inherited. In this connection he quotes the utterance of Schiller in "Wallenstein"—"It is the spirit which creates the body."

But there are also considerations, still more completely overlooked, which may be included under the common name of functional adaptation, and which bear upon the effects of function in modifying the internal structure of the organs.

We find that Hermann Meyer* has detected what may be called a special architecture in the spongy tissue of bones, which always represents the lines of maximum pressure or strain to which the organ is exposed. Thus what may be called the bone-beams are so placed as to produce the greatest strength with the smallest expenditure of material. Other anatomists, J. Wolf, H. Wolfermann, Bardeleben, &c., have confirmed these observations and extended them to almost all the bones of man and of several other mammals.

A teleologist (Paleyan) or the like, admitting these facts, would claim this very structure as proof of special design and of individual creation. But it has been discovered by J. Wolff and confirmed by Kastor, Martini, and L. Rabe that such structural peculiarities are not something fixed, inherited, and inborn, but are capable of modification according to circumstances. Thus, if a bone is fractured and reunited in a crooked position, the lines of greatest firmness disappear from their normal places and take up new positions

* Archiv für Anatomie und Physiologie, 1869.

in accordance with the modified direction of maximum strain or pressure. Hence the organism makes its own adaptations. Exceptional firmness is not designed to bear the strain, but the strain determines the firmness.

Professor Bardeleben and Professor H. Meyer have also communicated to Dr. Roux, as the result of researches not yet fully completed, that the fibres of the sheaths inclosing the muscles run likewise in the direction of the greatest strain. None of these arrangements can conceivably be due to Natural Selection. Passing over other illustrations of adaptation to be explained neither teleologically nor by selection, we come to the heredity of the effects of functional adaptation. However great may be the combined efficacy of embryonic variation and of selection, there is at least one occurrence in the evolution of the animal kingdom which is distinctly beyond their power. There is one point of which we can maintain that a step in advance must have been taken, not successively in single organs, but simultaneously in almost all organs, since advantageous variation in one or other part would not have been sufficient. This point is the substitution of an aërial for an aquatic life. The more closely we examine the conditions perhaps thousands in number, involved in the transit from the water to the land, the more we are convinced that such a change, however gradual, cannot be effected by Natural Selection. An animal attempting this transit would be at first distressed by the unwonted weight of its body and limbs, no longer supported by the water. In attempts at locomotion it must use its muscles in different co-ordinations. The bones, the cartilages, and sinews have new and heavier duties. The blood, now exposed for the first time to the full force of gravitation tends to leave the brain and spinal marrow, and to counteract this tendency and prevent an anæmia of the nerve-centres the entire circulatory mechanism must undergo a change. Oxidation will be deficient, now the lungs alone have to supply the entire demands of the system. The drying of the skin, the gills, and the lateral organs will cause abnormal sensations. The perception of the external world will be modified, and the senses, for the time being, will be thrown almost into inactivity. It may be, of course, admitted that the first visits of the animal to the dry land would be brief, and that an abode in shallow pools, *e.g.* during the recess of the tide, might in some respects form a transition-stage. Still the necessity of a simultaneous change in almost every organ of the body is apparent. Now functional adaptation on any change of the vital conditions is capable

of effecting simultaneously suitable variations in all the organs concerned.

This simultaneous action, perhaps, in millions of parts must be considered as its characteristic in contradiction to the *modus operandi* of selection, which can develop only a very few properties at once. The question of heredity, upon which Dr. Roux throws a new light, must be for the present passed over in silence that we may proceed to the main subject—the conflict of parts in the organism. It must be remembered that even in the highest animals centralisation is not so complete as is popularly supposed. The foundation of the conflict of parts is their inequality; hence arises a struggle in consequence of growth and of the transformation of matter. It will be understood that each unity can come into collision only with unities of the same order. There can be no conflict between a cell and, *e.g.*, an organ.

Passing over the struggles of the molecules, the cells, and the tissues we may find this principle of conflict or competition most clearly shown in the organs. We find here heterogeneous parts contending for two requisites—room and nourishment. As a consequence it follows that only those combinations of organs can subsist in which parts chemically and physiologically non-equivalent can yet maintain a morphological equilibrium. For if one part were so successfull so powerful in its growth as quite to suppress the others, the whole must perish.

Though the inter-action of the organs has long been known and studied, it has not been viewed as a selective struggle for space. The mutual limitation of the intestines, especially the passive dependence of the shape of the liver, was noticed even by Vesalius. Rott has shown that in cases where the right kidney is wanting the normal depression corresponding to this organ is absent. The lungs depend in their size and form on the heart, the shape of the thoracic cavity, the diaphragm, &c. The cerebral hemispheres flatten the cerebellum. Muscles, *e.g.*, those of the calf, likewise flatten each other. This mutual conflict has led to the utmost utilisation of the available space. An increase of any organ is possible only at the expense of some other organ unless the latter has the power to resist its encroachments and compel it to grow merely in an outward direction. It must be noted that organs rarely if at all used may maintain themselves for a long time in places where they are exposed to no competition for space, as in the ear-muscles of man.

Dr. Roux is of opinion that this direct conflict of the organs for space will furnish a better explanation of many

of the phenomena which Darwin groups together under the principle "Economy of Growth," than can be obtained by referring them to natural selection.

The organs engage in conflict also for nutriment. Goethe and Geoffroy St. Hilaire admitted this principle in their law of the "compensation of growth," which declares that when an excess of nutriment is required for building up any particular part, others are more scantily nourished, and are thus reduced in size. Darwin scarcely gives this law due recognition.

In summing up the results of this internal contest, the author makes use of a happy illustration. To deduce all advantageous properties of an organism from the results of direct selection in the struggle for existence with other individuals and with the outer world, is as great an error as would be committed by a sociologist or philosophical historian who should attempt to explain all the arrangements of a state in legislation, executive administration, science, art, commerce, and manufactures, from the effects of wars with neighbouring powers.

We have thus given a very meagre outline of a new factor in organic evolution. The idea of Dr. Roux seems to us to deserve most careful experimental investigation. Its true value can only be learnt from its actual application to some of the many unsolved problems with which the followers of Darwin and Wallace have so far contended with doubtful success. We do not suppose, nor does Dr. Roux for a moment insinuate, that the struggle within the organism, the conflict of parts, is the one and only consideration necessary to supplement natural selection. But we believe that it will be found of great service, and that it will prove especially efficient in explaining many of those minute delicate contrivances and cases of purposiveness upon which the advocates of individual creation still take their stand and upon which selection throws no clear light.

It may here be asked without for one moment seeking to undervalue the immense services which Darwin and Wallace have rendered to Science, whether evolutionists are not returning to a position more like that of Lamarck? Natural selection is no longer all in all. It requires the aid of the principle of use and disuse, of the influence of the external medium as analysed by Semper and, as we now see, of the internal conflict of Dr. Roux. Perhaps other agents which take part in the development of the organic world may yet be discovered, and may enable biologists to deal satisfactorily with the serious doubts which yet beset the question.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 224.)

IN the year 1764, Priestly, who was at the time a tutor in an academy in Warrington, published an Essay on a course of liberal education for civil and active life. "It seems," he remarks in this Essay, "to be a defect in our present system of public education, that a proper course of studies is not provided for gentlemen who are designed to fill the principal stations of *active life*, distinct from those which are adapted to the *learned professions*. We have hardly any medium between an education for the counting-house, consisting of writing, arithmetic, and merchants' accounts, and a method of institution in the abstract sciences; so that we have nothing liberal that is worth the attention of gentlemen whose views neither of these two opposite plans may suit.

"Formerly none but the clergy were thought to have occasion for learning. It was natural, therefore, that the whole plan of education, from the grammar-school to the finishing at the university, should be calculated for their use. If a few other persons, who were not designed for holy orders, offered themselves for education, it could not be expected that a course of studies should be provided for them only. And, indeed, as all those persons who superintended the business of education were of the *clerical order*, and had themselves been taught nothing but the rhetoric, logic, and school-divinity, or civil law, which comprised the whole compass of human learning for several centuries, it could not be expected that they should entertain larger or more liberal views of education; and still less that they should strike out a course of study for the use of men who were universally thought to have no need of study, and of whom few were so sensible of their own wants as to desire any such advantage.

"Besides, in those days, the great ends of human society seem to have been but little understood. . . . Few persons imagined what were the true sources of wealth, power, and happiness in a nation. Commerce was little understood, or even attended to. . . . *And thus, men's views being narrow, little previous furniture of mind was requisite to conduct them.*

"But the situation of things at present is vastly different from what it was two or three centuries ago. The objects of human attention are prodigiously multiplied; the connexions of states are extended. . . . In this critical posture

of affairs more lights and superior industry are requisite; . . . and consequently *a different and better furniture of mind is requisite to be brought into the business of life.*

"This is certainly a call upon us to examine the state of *education* in this country, *and to consider how those years are employed which men pass* previous to their entering into the world; for upon this their future behaviour and success must, in a great measure, depend. *A transition which is not easy can never be made with advantage,* and therefore it is certainly our wisdom to contrive that the studies of youth should tend to fit them for the business of manhood, and that the objects of their attention, and turn of thinking in younger life, *should not be too remote from the destined employment of their riper years.* If this be not attended to, they must necessarily be mere novices upon entering the great world, be almost unavoidably embarrassed in their conduct, and, after all the time and expense bestowed upon their education, *be indebted to a series of blunders for the most useful knowledge they will ever acquire.*

"In what manner soever those gentlemen who are not of any learned profession, but who, in other capacities, have rendered the most important services to their country, came by that knowledge which made them capable of it, I appeal to themselves whether any considerable share of it was acquired till they had finished their studies at the university. So remote is the general course of study at places of the most liberal education among us *from the business of civil life.*"

One hundred and twenty years have very nearly passed away since Priestly first published his Essay; yet the complaint he made of the want of a system of school education suitable for boys intended for trade and commerce, or, as he phrased it, "for civil and active life, a course of studies that would best adapt them for the destined employments of riper years," is still unprovided for this class of youths in the United Kingdom. The children of the poorer classes have been provided by the State since Priestly's time, with schools, which exist in almost every village and in every district in large towns; with teachers who are trained for their work; with inspectors to see that the prescribed course of studies is fully and efficiently carried out; and the system of education is being continually improved. The higher classes are also provided with well-endowed public schools and universities; but "the middle class is dependent still, to a great extent, for its education on private desultory enterprise: this class, in this land of education, gets *nothing* out of the millions given annually for this purpose to every class except themselves."

The grammar-schools of the country are of course open to boys intended for trade and commerce, as well as to those who, after leaving school, are to proceed to one of the universities, yet the teaching staff and the course of studies provided in these schools are mainly intended for the education of the latter class, although in most country grammar-schools they form but a very small percentage of the entire number of the pupils. One of the London daily papers, in commenting on the result of the recent competition for the Cambridge Classical Tripos, gave as one of the reasons why pupils from the country grammar-schools frequently gain higher prizes at Cambridge and Oxford than the pupils from the great public schools, that it was owing to the large schools being, in comparison with small establishments, conspicuously *under-mastered;* at country grammar-schools the percentage of boys who are going to universities is comparatively low. Frequently at these smaller institutions there are only one or two pupils destined for Oxford or Cambridge, and the teachers devote themselves with extraordinary assiduity to this small number, in comparison to the rest of the pupils. The education of the many in such schools must be more or less sacrificed for the scholastic advancement of the few; but the evil does not terminate with the schools that yearly have one or more pupils preparing for the university, but extends to schools that never even have one pupil. Not many years have passed away when, in such schools, if a boy learned Latin he was not taught even English grammar, and all other subjects that would have tended to fit him for the business of life were equally neglected; and it is to be feared that in many country grammar-schools the state of education has not been much improved since that period. Attempts have been made to rectify some of the evils by combining in one Institution three separate schools, viz., an upper, a middle, and a lower school; but such a system will never equal the one adopted in Germany. In that country they have distinct and separate schools for different systems of education; they have, as we have, elementary and classical schools; but they have, what we have not, the *real* schools, and trade and mercantile schools. Other continental countries have established similar schools; but whilst France has developed most fully the apprenticeship schools, Germany has most fully developed schools for the education of those who are intended to be Directories of industries, and for those intended for a purely commercial career. We need not therefore be surprised that the present Chief Secretary for Ireland, the Right Hon. W. E. Forster, when speaking a few years ago on middle class education, stated that a young German

who had to make his way in the world as a clerk had a much better chance than a young Englishman,—not because he was naturally quicker, but because, in consequence of the German system, he had received a much better education to fit him for business; or that Mr. Felkin, in his work "Technical Education in a Saxon Town," should thus express himself:—"Chemnitz is a large manufacturing town, like Nottingham, resembling it, too, in the fact that hosiery is one of its staple manufactures; and, moreover, as the town of Chemnitz has already taken away the glove trade from Nottingham, and is, in the opinion of many, slowly undermining the trade in cotton hosiery too, it cannot but be important to the people of Nottingham to know something of the educational advantages which have enabled the Saxons to do this. For, in the writer's opinion, neither in *physique* nor in energy and natural ability are these Saxons equal to Englishmen. On the contrary, the human raw material in Saxony is inferior to that of the Midland Counties, and yet the weaker race takes the bread out of the mouth of the stronger, and competes with it in the markets of the world. What enables it to do this?" The answer is, that it is mainly due to the Saxon's possessing superior educational advantages. Nor is it surprising that so many parents in this land of educational endowments and expenditure on education should send, or proceed with, their children to Germany,—a country "where there are no close and wealthy scholastic corporations; no rich independent church claiming a monopoly of education, and instinctively averse to change; and no blind adherence to old paths,"—to obtain for them an education suitable and adapted for their future pursuits in life. When staying in Bonn, some years ago, I saw, with feelings akin to pain, an English town springing up, inhabited, I was told, almost entirely by those who had come over for the purpose of having their children educated.

The first and essential requisite for an improved system of Technical education in England is the establishment of schools resembling the Real and Trade Schools of Germany. Without such schools the Technical Colleges which have been recently established in the country, by the munificence of private individuals, will not be of that service to the country they otherwise would be; for the students proceeding to them will too frequently have but a very imperfect acquaintance with one or more of the natural sciences: hence the Colleges will in part have to be turned into Elementary Science Schools, or the students will obtain but a very imperfect knowledge of such subjects.

ANALYSES OF BOOKS.

Evenings at Home in Spiritual Seance Welded together by a Species of Autobiography. By Miss HOUGHTON. Second Series. London: E. W. Allen.

THIS volume is a continuation of a work which we had the pleasure of noticing a little while ago. Some most remarkable phenomena are here recorded. Thus at a séance at which the author was present "a sudden and violent motion among the tubes startled us, and a quantity of snow and ice came down upon the table. We had the light at once and found that although such a large quantity had fallen, there was none upon the carpet or in any other part of the room. The lumps of ice were irregular in size, but the smallest must have weighed more than half a pound, and they where literally buried in snow. I noticed that the snow had the peculiarities of newly-fallen snow, and for a moment distinct feathery flakes could be seen, but the warmth of the room soon changed this appearance." The feathery character of the snow is the important point, for ice and snow, if packed in some non-conducting substance can be preserved for a considerable time in temperatures quite as high as that of a comfortable room.

The following is an almost equally uncomfortable manifestation. "We had a feeling as if something very light indeed were falling upon us . . . . . at last we clearly made out that it was small downy feathers." On a light being made it appeared that the floor was covered over with down. It is added that on making a search on the floor above there was found the empty case of what had that morning been a feather bed!

On another occasion "when we were told to have a light we found the table was quite heaped up with flowers in delicious profusion. Mrs. Guppy, taking up one of the cowslips, called my attention to the fact that, on squeezing the end of the stalk, juice flowed instantly—a proof that they were but just plucked, for that even in ten minutes after flowers are gathered a kind of healing or drying process takes place where the stem has been broken off, so that it will not bleed."

If we may be permitted to make a suggestion we would ask Spiritualists to have brought by their unseen visitors, a live Goliathus, or Ornithoptera. No such creatures have ever been brought to Europe alive, and probably could not be unless a ship

were specially fitted up as a floating conservatory. They could be at once identified by any naturalist, and would be, of course, incapable of being counterfeited by any juggler.

Miss Houghton received at her exhibition, a visit from an Evolutionist whose theory "bothered" her "not for one moment as to the thought of accepting it, but as to how the specious arguments were to be met." She "appealed for counsel" to some spiritual being and received the following reply: "Look at the rainbow. Where are the links in creation so close as the tints in its arching bow? Who may say where one shades off into another? Yet the blue remains blue, the red, red, and the yellow, yellow; the several creations are distinct, however closely they may be allied, or however harmoniously they may be blended." We doubt if a poorer argument in favour of mechanical creation was ever put forward.

Amongst other strange phenomena we find an account of Mrs. Guppy's being "transported by spirits from her home at Highbury to Mr. Williams's Séance in Lamb's Conduit Street."

The strangest matter in these pages, however, is an extract from the "South London Courier" of March 2nd, 1872. "A few months ago, a couple about to be married took a house in Berkeley Square, and upon concluding the transfer they were solemnly warned by the agent that a certain room in the house was haunted by a ghost. The mother of the bride said she would have no fear to sleep in the haunted room, as she was in the house superintending the arrival of the furniture. The lady was not alone in the house at the time of her venture; there were two or three servants also sleeping there. Nothing alarming was heard by them during the night, but the next morning when they went to call up their mistress they found her dead in bed with open eyes staring wildly at the ceiling. A medical man who was called in could give no satisfactory cause of death, which seemed to have taken place through some violent shock to the brain and nerves. But the newly married couple, much shocked as they were at the untimely death of their relative, were quite incredulous as to its having been caused by any supernatural agency; the husband at length prevailed upon his wife to consent to his making trial of the powers of the ghost. The lady stipulated that she should sleep in an adjoining passage, and that she should have the protection of a fierce bulldog and a pair of pistols, while two policemen were to be within call in another room. The gentleman retired to rest without any anxiety, taking with him a pair of revolvers. He also agreed to ring a bell twice should the ghost appear. About half past twelve the anxious wife heard the bell ring, first rather rapidly and then feebly. She flew into the haunted room and found her husband dead with his eyes fixedly gazing at the ceiling." The editor of the "South London Courier," Mr. J. E. Muddock, of 121, Fleet Street, in reply to inquiries wrote:—"While not being

able to give you names and particulars at present respecting the Berkeley Square ghost, I vouch for the accuracy of the facts as narrated, and you are at liberty to use my name if you think proper." It is added that in each case a coroner's inquest was held, the verdict being that half blasphemous and wholly foolish survival "died by the visitation of God."

Miss Houghton gives it as her opinion that the victims did not die of fright, but had been literally murdered by malignant spirits.

We should feel much obliged to any one who could furnish us with either a confirmation or explanation, or a contradiction of this unpleasant story. There are several other "ghost stories" in the book, though none of so serious, or we may add so definite, a character. We have also some notice of the "elementaries,"—beings unconnected with man in any way, and described as of a lower grade.

The Slade trial is not overlooked. On this affair we have already pronounced our opinion, and need not again return to it further than to say that it has been out-Heroded by the attack upon Professor Ferrier. There is here (p. 257) a curious incident. A stationer named Lake, in Great Russell Street, had supplied Slade with slates. The prosecution, having heard of this "came to subpœna him to give evidence. When they found that the slate were just common ones with no contrivances of any kind, they *did not* summon him. All they had wanted was proofs of fraud."

A letter to Miss Houghton from a Rev. Mr. Barrett supplies further proof how Spiritualism is allying itself with one of the saddest fanaticisms of the day. He says "vivisection among other iniquities will be put down by terrible judgments from God!" The same writer gives a new remedy for illness, more powerful than mesmerism, to wit, solarised sugar. The finest powdered loaf sugar is exposed to the sun on plates for two successive days, at the same time each day, and is then preserved, covered with silk in the dark. Three teaspoonfuls daily are to be taken for five or six weeks.

We must pronounce this book, like its companion volume, worthy the careful study of the psychologist.

The Relation of Brain to Mind. A lecture delivered to the Dialectic Society of the University of Glasgow. By JOHN CLELAND, M.D., D.Sc., F.R.S., Professor of Anatomy. Glasgow: Maclehose and Sons.

WE have here in brief compass an exceedingly able summary of the present results of modern science on one of the most important

and difficult of all questions. The author belongs to a class of thinkers, unhappily, far from common; men who do not profess to be wise beyond what is demonstrated, and who will frankly confess ignorance rather than indulge in vague assumptions. He opens his lecture with a provisional definition of life. "Life is the capability of undergoing that series of actions by which an individual is not only maintained but determinately changed or developed by the attraction and disposal of particles drawn in from without and the extrusion of others." Whether any definition of such a primary fact as life will ever be fully satisfactory, we can scarcely venture to say; but Dr. Cleland's attempt is perhaps open to fewer objections than any which has been put before the world, especially if construed, as it may, to include reproduction.

Whilst speaking of albumenoid matter, without which no vital function is ever performed, the author makes some exceedingly happy remarks on the question of spontaneous generation, or as it is now more learnedly termed, "abiogenesis." "It is worth while to pause for a moment to note that whilet, here are enormous numbers of organic substances filling up the gradations of complexity between protoplasm and the simpler compounds of the organic world, not one of them occurs native save as a product of pre-existent protoplasm." This is an important and undeniable truth: between the products of the mineral kingdom —save where these have been derived from the decomposition of matters once living—we find no transition steps leading to, or even pointing in the direction of, the albumenoids. It may not be irrelevant to point out that the organic syntheses, of which modern chemistry is so proud, start not from *bona fide* dead matter but from the remains of what was once living. Dr. Cleland proceeds:—"Hence it follows that the numerous believers at the present day in the antiquated notion of the evolution of life from dead matter are placed in this dilemma—either they must admit that protoplasm, in the first instance, had its origin in other than the ordinary operations of inorganic nature, by a sudden spring from inorganic compounds totally at variance with the whole notion of an evolution, or they must be content to imagine an immense series of operations in days gone by altogether different from anything that takes place now, whereby simpler organic substances were formed first and protoplasm was formed out of them." An eminent man of science, whilst fully admitting the failure of all attempts made at obtaining life without antecedent life, still thinks that if it were given us to look back to the earlier ages of the world, we should see what now appears impossible actually coming to pass. We wonder which horn of the dilemma he would have elected?

Of the two great vital functions—nutrition and irritability—our author gives his attention to the latter. He fully accepts the "conclusion that with every mental action, whether intellectual, emotional, or volitional, a corresponding amount of oxidation

of material takes place in the brain." This correspondence, he holds, is of the strictest character. But he does not agree with the assertion that the thought and the accompanying coincident cerebral change are one and the same thing. Such view he finds unthinkable, because "any physical change, whatever its character in detail, is mere movement in space, and that is an idea utterly incomparable with the idea of thought." He mentions another difficulty in the way of identifying thought with its physical conditions:—"Each thought, each memory, has a distinctness from all others, at the same time that it exists for the thinker alone; while not only is physical change an objective antecedent of the subjective changes by which it is appreciated, but the particular physical change which takes place in any nerve-cell or living corpuscle of the brain when in action is always of one and the selfsame desciption, to wit, a combustion or oxidation and a corresponding electric disturbance."

Concerning these electric changes he adds:—"Living muscle and nerve separated in blocks from the body, so long as they are at rest, are in a state of remarkable electric tension of a description different from anything found in dead matter; but as soon as they are irritated this tension is diminished or ceases." This phenomenon is not understood, and calls for prolonged study,—study which, by the way, will scarcely be possible in England under its present hysterical *regime*.

We come to another problem: it is admitted that though the sensation bears a proportion to the stimulus, yet "the amount of subsequent mental action set up by a sensation has no quantitative relation to the sensation, and consequently none to the amount of energy liberated by the stimulus.

The author, accepting—as will be remembered—the mind as an immaterial entity, finds it insufficient to say that the mental and physical actions are simultaneous. The relation seems closer. "In the case of sensation you come to a stage—a transition-point—at which the purely physical changes are followed by changes both physical and mental, whilst in the origin of voluntary and emotional actions of the body there is a point of converse transition at which mental plus physical change is followed by purely physical change." The question naturally arises, How are these transitions to be harmonised with the principle of the conservation of energy? Dr. Cleland asks "if energy has here a wider range than the material universe?" Two answers only seem to him conceivable. Either the physical results of the action in the nerve-cells amount to the same sum as they would in case of the same action in cells unconnected with the mind, or to a smaller sum. The former alternative involves a breach of the principle of the conservation of energy, because, though brought about by physical energy, it is something over and above the normal results. If the physical results amount to a less sum, the difference is transformed from physical to psy-

chical energy, and a bridge looms vaguely between, shall we say, matter and spirit? Dr. Cleland accepts the latter suggestion, and, though with admitted diffidence, formulates the startling conclusion that "a certain minute of energy in the production of sensation quits the physical for the psychical world, instantaneously to return again in the excitation effected by the sentient mind on the substance of the brain." But if thought and physical energy are mutually convertible, is not thought, after all, a form of physical energy? We can understand more or less clearly the mutual transformation of mechanical work, of heat, light, electricity, and magnetism; but if we see such energy transformed into thought, and thought re-transformed into physical energy, we are perplexed if the two are essentially distinct. To understand such a conversion is fully as difficult as to understand the identity of thought and cerebral change.

Whilst, however, we do not for the present feel free to accept Dr. Cleland's startling conclusion, we think that he has done well to raise a question which has hitherto been accidentally or purposely overlooked. The steps between an impression upon a sense-organ and the operations of mind and brain have not been closely tracked.

We strongly recommend this pamphlet to the serious study of all who feel an interest in questions concerning the human mind. No special biological knowledge is required for its understanding, and it is full of important and suggestive matter at which we have merely taken a passing glance.

Report on the Botanic Gardens, Trinidad, for 1880, *laid before the Legislative Council October* 1*st*, 1881. Port of Spain: Government Printing-Office.

We have here a most interesting and many-sided report bearing on the climate, the flora and fauna, the resources and production, present and prospective, of the island. Meteorological observations have been made of a regular and thoroughgoing character, so as to give a very fair picture of the climate. The annual and monthly rainfall, the atmospheric humidity, the cloudiness, the atmospheric pressure, and the temperature are very fully recorded. In the last point we notice the great regularity of an equatorial climate. For 1879 the mean temperature was 80·3° F. at 9.30 a.m., and 80·9 at 3 p.m. The yearly mean temperature for the nineteen years from 1862 to 1880, as calculated from the mean maxima and mean minima, ranged from 76·0 for February to 79·4 in May, and 79·0 F. both in September and October. There are thus two maximum points, and the yearly average

range of temperature from the coldest to the hottest month does not exceed 3° F. The average atmospheric pressure for the same years is 29·878 inches in the morning and 29·791 in the afternoon.

The cloudiness is given on a scale where 0 denotes a perfectly clear sky and 10 total cloudiness. In this department we beg to suggest that more satisfactory results would be obtained with less trouble by means of Mr. Winstanley's radiograph (see *Journal of Science*, 1881, p. 218), which records automatically both the duration of actual sunshine and its intensity. It will, perhaps, surprise some readers to learn that the skies of Trinidad are very far from cloudless. During the above-mentioned nineteen years the lowest monthly cloudiness, for the months of February and November respectively, is 4·9 and 4·7, whilst in July and August it reaches 7·1. The atmospheric humidity is considerable, if 1·000 stands for perfect saturation of the air with aqueous vapour, the lowest degree of humidity, 0·674, is given as occurring in April and the highest, 0·841, in August. The average yearly rainfall for nineteen years, 66·39 inches, though about on a level with that of the rainiest parts of Britain, is not large for a region exposed to a tropical sun. The monthly rainfall has its maximum, 11·28 inches in August, and its minimum, 1·85 inches in April. The author remarks that one year, with the exceptional rainfall of 84 inches, he found in one part of the gardens the subsoil at the depth of 20 inches quite dust dry. The substratum in the Botanical Gardens is, probably, not directly moistened by the rain oftener than once in five or six years.

Insect pests are not wanting either in the gardens or in the island generally. The parasol-ants—probably the leaf-cutters—are said to have been unusually troublesome. We feel curious to know whether the nests have been attacked with the agencies proposed by our late friend, Thomas Belt—viz., carbolic acid and corrosive sublimate. Wasps and blight—probably aphides or scale insects—have also given annoyance.

We find here a remark on the conditions of tree-life, which is worthy of careful consideration. Says the author:—"It is a regrettable fact that the conditions of well-kept grounds are as a rule inimical to long-lived trees of majestic size and form. This is the case in temperate regions, but far more so here. The mischief arises from the removal of all fallen leaves and branches under the trees, which in a state of nature protect the roots from the sun and nourish the tree through them. It is well known that the majority of our forest trees, when their stems and base and surface roots are suddenly exposed to the sun, cease at once to thrive, and soon die outright. By the free admission of sun and air to the roots near the surface, the most harmful part of the dry season is intensified, and the beneficial influence of the wet season is greatly diminished." It is to be noted that the

combination of beauty with neatness or "tidiness" is one of the most difficult tasks that man or even woman can attempt. It is also found that a love for the beautiful is not common nor highly developed where ultra-tidiness is rampant.

It must be remembered that a great part of the time and attention of the author, Mr. H. Pascoe, the Government Botanist, is taken up with experiments on the acclimatisation of valuable trees and plants from other tropical or sub-tropical countries, and in improving and ennobling species which are either aboriginal or have been introduced some time ago. We learn that the nutmeg tree is fully naturalised, and proves exceedingly productive. The yield per tree is over 20 lbs. of nutmegs weighed as ready for the market, and worth, on an average, 2s. 2d. per lb. Allowing on thirty female trees per acre, this signified a return of £60 yearly per acre.

Concerning the Liberian coffee (*Coffea liberica*) we find some interesting particulars. There is much less uncertainty with it as regards the "setting" of the fruit than occurs with *Coffea arabica*, and the tree prospers at a lower altitude. On the other hand, the proportion of the hull and husk and of the "parchment" is greater in the Liberian species. In flavour it appears inferior to the Arabian berry. The samples tested were distinctly wanting in the fine piquant aromatic flavour characteristic of Moka and the fine Trinidad Creole coffee. The comparative analysis of the two kinds, as given by Professor McCarthy, F.C.S., the Government Analyst, shows that whilst the Arabian berry contains 1·65 per cent. of caffeine the Liberian has only 0·77. The latter kind is, however, valued for mixing. It may be remarked that in France, and to some extent in America, different growths of coffee are judiciously blended. The only "blending" we understand in England is smothering the aroma of coffee under loads of chicory.

Attempts have been made to introduce into Trinidad the Litchee (*Nephelium Litchee*), and though the climate is too uniformly hot, the fruits have been delicious, resembling a high class muscat grape in consistence and flavour. As may be concluded from Professor McCarthy's analysis, these fruits, being rich in levulose and tartaric acid, seem likely to prove in China, Mauritius, Queensland, &c., a suitable material for wine. An efficient substitute for the grape is at present greatly to be desired.

The Chinese wax-tree (*Stillingia sebifera*) lives in Trinidad, but does not reach full vigour. In a climate less completely tropical it will, doubtless, be worthy of extensive cultivation, as its wax is of fine quality and is produced in abundance. We regret that lack of space does not allow us to notice the reports on the improvement of the cacao-crop by selection of strain, by improved culture, and by greater care in curing the beans, as also the experiments on the introduction of the African oil-palm,

the true Durian, and many other valuable trees. We must be permitted to record our opinion that in Mr. Pascoe the colony possesses an indefatigable public servant, endowed with the all-important qualifications of a love for his duties, a thorough acquaintance with the conditions of plant-life, and a suggestive mind. The more it is to be regretted that he labours under marked disadvantages. The soil and site of the Botanical Gardens are not too suitable, and the grounds are not even securely fenced in. Stray cattle effect an entrance in the night, and may easily destroy the result of prolonged and patient labour. In these days, when the chemical science of Germany, France, &c., is waging a formal and bitter war against tropical agriculture, attempting to produce dyes, spices, medicines, &c., artificially, it is incumbent upon our colonial planters to defend themselves by the aid of chemistry and vegetable physiology, seeking to improve the quality and the yield of their crops. Liberal facilities afforded to able men will be found in the end an admirable investment.

Geology of the Counties of England and of North and South Wales. By W. Jerome Harrison, F.G.S. Science Demonstrator for the Birmingham School Board, late Curator, Leicester Town Museum. London: Kelly and Co.

We have here a most laborious, and we do not hesitate to say, a most useful compilation. There are, we believe, numbers of persons scattered up and down England who have a more or less complete acquaintance with geology such as may be gathered from books. But they naturally ask where some of the phenomena they have read about may be seen and personally examined without the time and trouble of a journey purposely undertaken to some celebrated locality? To such persons Mr. Harrison addresses himself; he tells them what there is to be observed in their own neighbourhoods, what to look for and where to look for it. By this means the student may make himself acquainted with the characteristic features of each formation in a relatively short time. Those again, who have already mastered the alphabet of the Science and wish to become observers, will find here useful guidance. Observation, we need scarcely say, requires a liberal outlay of time. Hence it is best that every qualified person should know what there is in his own immediate locality which needs closer examination. We quote here the following sentence which, though applying more especially to the county of Bucks, is not irrelevant elsewhere. "There remains an extensive field to be filled up by those who

live on the spot. Every quarry, brick pit, railway cutting, or opening of whatever kind into the earth, should be diligently examined, carefully measured and drawn, and continually examined for fossils; in this way the broad outlines we now possess must be filled up, and if only one person in each parish could be induced to undertake such work, the gain to geological inquiry would be of real and great value." This is obvious, yet such close and constant examination can only be undertaken by local observers, and it is hence very important that such should have every facility given them. The work before us will, we think, assist no little.

The remarks on the characteristic scenery of the counties as resulting from their geological features are interesting and correct. The figure showing the cliffs of lower keuper conglomerate on Alderley Edge, Cheshire, will be at once recognised by all who knew that locality before it was invaded by building speculators. By the way, the author, speaking of the copper ores of Alderley Edge, makes no mention of the accompanying ores of cobalt, nickel, and vanadium.

The description of Kinderscout, the culminating point or rather ridge of Derbyshire, is strikingly correct. The view of the terraced lower escarpment of the chalk east of Chalgrave (Beds) is very characteristic. Concerning a similar set of terraces to be seen between Cheddington and Marston Gate Station on the Aylesbury Railway, we had once an argument with a local gentleman who persisted in declaring them to be artificial.

Another important feature of the work is the list of local natural history societies and museums, prefixed to the description of each county, along with a catalogue of important works or papers on the local geology. The list of societies and museums is unfortunately very limited, though not from any shortcoming of the author's. In addition, there is a list of the more important books treating generally of the geology of England and Wales. There is also under each county a notice of the maps and publications of the geological survey which may be usefully consulted.

Concerning local museums it may here be remarked, that much remains to be done before they will give the visitor a tolerably fair idea either of the stratigraphy, the palæontology, or, what might seem to appeal more directly to popular demands, the economic geology of the district. This is not as it should be, but we fear that in some influential minds the efficiency of a museum, a society, or a school of science, is less aimed at than its being brought under departmental control and centralisation.

Concerning the body of the book we can say but little, especially as the author does not profess to put forward either new facts or novel theories. In speaking of the Isle of Wight, however, he says:—"In these deposits of Wealden age we have evidence of a mighty river which flowed from west to east

draining a continent which stretched far into the Atlantic; the strata formed in its estuary now extends from the Vale of Wardour, in Wiltshire, to the Boulonnais in France, a distance of 200 miles." Surely whatever evidence exists for the former existence of such a river ought to be taken into account in discussing the difficult question of the permanence or mutability of land and sea areas. The opinion is now widely entertained that former extensions of land have existed where the seas are now shallow, but that the beds of the great oceans are, and have been, permanent depressions in the earth's crust. As the question to us at least seems not fully decided, we think the considerations to which Mr. Harrison refers ought to be carefully weighed.

In ending this brief notice we must express our conviction that the "Geology of the English Counties" supplies and fills up an important gap in the literature of the science, and will be found a most valuable book of reference.

Vibratory Motion in Sound. By J. D. Everett, M.A., D.C.L., F.R.S., F.R.S.E., Professor of Natural Philosophy in the Queen's College, Belfast. London: Longmans and Co.

The branch of physics which treats of sound has latterly risen in importance, and may now fairly claim an equal rank with optics, thermology, and the sciences of electricity and magnetism. In the work before us we have a mathematical treatment of the subject of vibratory motion. In the successive chapters the author treats of simple harmonic vibration; of the composition of motions of translation; the composition of vibrations of the same period; of simple harmonic undulation; of the composition of two simple undulations of the same wavelengths, or of different periods; the propagation and reflection of sonorous undulations; on the stationary vibration of strings and columns of air; on the energy of vibrations; on simple and compound tones, and on musical intervals.

The treatise is specially intended for students already versed in the elements of dynamics.

An Attempt to Prove Newton's Law of Gravitation for a Resisting Medium. By the Rev. G. T. CARRUTHERS, M.A., Chaplain of Moradabad, India.

THE author remarks, "the theory of Sir Isaac Newton is drawn up like some pretty fairy tale. It is all very beautiful, but it is not a description of what goes on in every-day life. Who can believe the following to be the facts which they are said to be by all astronomers? 1. Heavy and light bodies are sent the same distance by the application of the same one force-producing mass to them. 2. A rotating sphere sucks bodies to its surface instead of hurling them away from it. 3. Common earth or stone can do work of itself without anyone making it do it. 4. Matter can draw other matter to itself through long distances without ropes, arms, or any intervening agent. 5. There are pleasant places in space where revolving bodies, once set in motion, never require any further looking after, as they go on turning for ever without the renewal of the applied force. 6. Gases, air, and vapour will not fill and permeate freely the room they are in. 7. Nature, without the aid of any known engine, in ages long past hurled the planets all at the same time along straight lines with enormous velocities, and with a speed calculated to the very foot per second, and having shown this care in putting them straight it then placed a body to pull them out of that course by a force acting under a law that no one can understand, except advanced mathematicians. It naturally died in the effort, for it never touched them again, and has attempted nothing like it since. 8. To these must be added another well-received theory, which, however, is not altogether connected with the Newtonian philosophy. Most of the matter in space has been made so hot that nothing that we know of can live in the greatest worlds; and even if the spheres were not hot, yet the force of gravity is so great that only flat creatures could live in them. Most of the spheres which are not hot, and in which the weights are not too hot for ordinary creatures to bear, are so cold that there cannot be a trace of life there, or of vegetation, and in moons living things would be thankful to get water and to breathe fresh air."

Here, surely, is matter for reflection.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE SUN-SPOTS.

To the Editor of the Journal of Science.

Sir,—One cannot help being struck with the insufficiency of the theories of the sun-spots enumerated by M. Louis Figuier, in Chapter VIII. of his "Day after Death" (edition 1881). They only explain *accidental* spots; but if I understand rightly these spots are periodically exact, and located, *i.e.*, every eleven (?) years they pass through a full set of phases, which are again repeated. This cannot be the result of the "scoria" of the "German Physicist," or the "clouds" of M. Kirchhoff, nor probably the "ascending and descending vapours" of M. Faye, because it is utterly impossible for any such accidental causes as these to repeat themselves regularly. They are evidently regulated, then, by an immutable law. Comparatively speaking, it is reasonable to suppose that these must indicate a thin gaseous photosphere upon a solid globe. That the photosphere is gasified metals, &c., seems thoroughly established by the spectroscope. There would, then, seem to be some tidal influence at work on the sun's surface, and the spots would be so many unflooded spots. That there is some dark substratum Nasmyth's groups seem to show decisively enough, for there can hardly be a shadow where all is light. Suppose the photosphere only revolves round the fixed globe—an orb at war with itself?—I am, &c.,

D. Y. C.

Leeds.

SPIRITUALISM AND THE ANTI-VIVISECTION MANIA.

An exceedingly able contributor to "Light" (M. A. Oxon) takes exception to our remarks that the paper read by Mrs. A. Kingsford, M.D., at a meeting of the British National Association of Spiritualists, and an essay in "Light" by Mr. Crosland, indicate a hostile feeling on the part of Spiritualists toward Biological Science. We fully admit the contention that a Society or Association is not bound by the acts of a single member. But there is nevertheless a distinction to be drawn which so acute a thinker as "M. A. Oxon" cannot fail to recognise. It is this:—Every Society has a certain range of subjects to which its attention as a Society is supposed to be limited. These subjects are not necessarily pointed out in the Laws or the Bye-laws of the Society, but the limitation is accepted both by members and by the outside public. So long as a member keeps within this pale the Society is not committed to his opinions, be they right or wrong; but if a member is allowed to travel beyond the boundary, and to discuss subjects which lie outside, it seems to us that the Society becomes responsible.

To take an instance: let us suppose that a violent attack upon Spiritualism were introduced at a meeting of the Institution of Civil Engineers; we feel certain that the speaker would be stopped, however hostile to Spiritualism the majority of those present might happen to be in their individual capacity. Moreover, if the reading of such a paper were permitted, we think that Spiritualists would have every right to complain that the platform of a supposed and ostensibly neutral body had been used in a hostile manner.

The case of Journals is substantially the same. We remember feeling exceedingly disgusted when the "Inventor's Record"—a purely technological paper—took a position hostile to Spiritualism on occasion of the "exposure" of a medium by a certain Herr Carl von Buch. We considered that our contemporary was acting altogether *ultra vires*, quite irrespective of the validity of his arguments.

It seems to us, in fine, that the British National Association, by allowing Dr. Anna Kingsford to read her paper, has acted like a State which in time of war allows its territory to be used by one of the belligerents as a "basis of operations."

Candidly speaking, we regret not having called attention to Mr. Podmore's reply to Mr. Crosland.

The Editor of the Journal of Science.

THE "ERRORS" OF THE OLD ANATOMISTS.

To the Editor of the Journal of Science.

SIR,—Whenever the result of modern investigation varies from that of the older anatomists, the latter are peremptorily condemned. Is this a perfectly safe procedure? Is it not open to doubt whether they might not have been right *then?* Some of the blunders are indeed extraordinary.

May not the different results yielded now, perhaps, arise from a further physiological evolution since then? Nor is this unplausible when we consider that it is more than 2000 years since Aristotle wrote. Hippocrates lived earlier still, and it is over 1600 years since Galen flourished.

E. g., if I am not mistaken, we are told that Galen describes the upper jaw as being divided into two bones, which is not the case now; hence Galen is condemned as wrong, or as only drawing his results from animal dissections. Would he have made such a mistake?

Therefore, looking at the matter in this light, one is surprised to see Prof. Huxley ("Science and Culture"), in defending one of Aristotle's "errors," say of certain others "Not so much to be called errors as *stupidities*. What is to be made of the statement that the sutures of women's skulls are different from those of men; that men, and sundry male animals, have more teeth than their females;* that the back of the skull is empty; and so on?" *Were* the heart, lungs, &c., as he describes; were also these things "stupidities" then? (as they undoubtedly would be if things were then as now).

It is argued that the ancients, and therefore our quoted philosophers, never dared to dissect a human body, yet it is impossible to get rid of the impression that they did (*see* Hallam, in his "Literature of Europe," Chap. II., § 37).

If Prof. Huxley is rightly reported, and is correct in his translation and authority, that human beings were dissected seems placed beyond doubt by the following extract from page 188 of "Science and Culture":—"The lung is divided into two parts; but in those animals which bring forth their young alive the separation is not equally well marked, *least of all in man.*"—(Aristotle, Book I., 16).

We know that, in spite of the immense prejudice against this "sacrilege," Mundinus, the father of modern anatomy in Italy, in the fifteenth century, managed to dissect "on the sly," when to

* It is a very familiar fact that some people amongst us only develop two incisors in each jaw, instead of the usual number, though this is not confined to females, I think, nowadays.

be found out might have been death; and so with Zerbi, of Verona; Berenger, of Carpi; and the great Vesalius, later on, whose students used to go and dig up their ghastly objects from their graves, and steal at midnight, tumbling back with their loathsome burdens.—I am, &c.,

D. Y. C.

Leeds.

FISHER'S "PHYSICS OF THE EARTH'S CRUST."

("Journal of Science," No. XCIX., March, 1882, p. 168.)

To the Editor of The Journal of Science.

SIR,—The Reviewer states that "an attempt has been made by an eminent authority to fix a maximum limit for the time which has elapsed from the solidification of the Earth's surface down to the present day," and adds that "the results reached . . . vary from 33 to 300 million years." The period of 33 million years is one obtained, not by the "eminent authority," but on his hypothesis, with the assumption of a lower temperature of solidification, by Mr. Fisher ("Physics of the Earth's Crust," note, p. 71). It appears from the Review as if Mr. Fisher attributes to Sir W. Thomson the conclusion that the rate of increase of the temperature within the Earth becomes *nil* at about 5000 feet below the surface. This is not Sir W. Thomson's conclusion, but Prof. Mohr's, and was deduced by him from an erroneous method of interpreting the Sperenberg observations ("Physics of the Earth's Crust," p. 12). Sir W. Thomson states, on the contrary, that the increase will not diminish sensibly for 100,000 feet or so. ("Secular Cooling of the Earth," Nat. Phil., p. 720).

Thirdly, the Reviewer has attributed to Prof. Tait a passage quoted by Mr. Fisher from a tract by the Bishop of Carlisle, in which the concluding clause alone is taken by the Bishop from Prof. Tait ("Physics of the Earth's Crust," note, p. 74).

NOTES.

Vivisection.—Last spring the naturalist, Carl Vogt, met at the Algerian Congress an English physiologist, Dr. Martin Lister, who informed him that because of the English law against vivisection he was obliged to leave that country whenever he wished to make experiments on animals. "Can you believe," said he, "that I was forced to leave my practice there, and start again professionally in France, so as to be able to make some experiments on horses necessary for the completion of a work already commenced? I applied to the English authorities, and they informed me that they would willingly close their eyes to the fact that I was practising vivisection, but if it pleased some clergyman or old woman to prosecute me, no one could prevent me from being heavily fined, or even imprisoned. I have therefore come to Toulouse, where I have kindly been supplied by the authorities with all necessaries." Carl Vogt accompanied this statement with the following remarks:—"In the case of a human being the doctor has the whole control, he practises the most dangerous operations, and administers the most violent medicines on his own responsibility. Why is it then more dangerous for animals than human beings? Why do we find it abominable to try the effects of a new remedy on an animal before using it for man?" M. Carl Vogt declares that there exists in Germany a movement analogous to that which led to the law against vivisection in England. M. Virchow fears that it may be successful.—*Medical Press and Circular.*

The American Association for the Advancement of Science will hold its thirty-first meeting in Montreal, Canada, during the week commencing on August 23rd, under the presidency of Prof. Dawson, LL.D., F.R.S., Principal of the McGill University. Twenty-five years have elapsed since its former meeting in Montreal, and in this period the Association has increased greatly in numbers and importance. The Committee have made arrangements with the various Steam-Ship Companies to encourage scientific men from Europe to attend the meetings of the Association.

According to the "Gazzetta di Napoli" the deaths from delirium tremens and chronic alcoholism are in Italy 1·65 per thousand; in England, 2·04; Norway, 2·36; Scotland, 3·29; Belgium and Switzerland, each 3·83; Sweden, 6·25; and New York, 12·08.

Signor Giunti ("Gazz. Chim.") has found an average of 0·8 per cent of copper in the excrements of bats.

Dr. O. Bütschli ("Zoologischer Anzeiger)" shows the non-existence of individual death in the Protozoa. These mono-cellular animals cease to exist as such in the act of propagation, and the individuality of each is split up into the two new individualities of its offspring. No organic matter is thrown out of vital activity, as occurs on the death of the Metazoa. A protozoon may perish by accident, but it does not necessarily carry, like the higher animals, the germs of death in itself.

"Picro-sulphuric acid," for the preservation of specimens, is made by taking 100 parts of a saturated solution of picric acid in cold water, and adding 2 parts of pure sulphuric acid. For insects this mixture is used undiluted, but for mollusks, &c., it is let down with three times its measure of water.—*Zoologist.*

Mr. Stradling, in an able paper on Snakes in the same journal, mentions the occurrence in the New Forest of *Coronella lævis*, a true snake not generally known to inhabit Britain.

At the April meeting of the Entomological Society it was stated that three queen wasps (*Vespa germanica*) were taken on January 15th of the present year—the earliest appearance on record.

At the same meeting Mr. Billups exhibited a new method of putting up small insects. They are gummed upon the circles of thin glass used for covering microscopic objects. These are again fixed at the back to a slip of card supported by a pin. In this manner the under side of the specimen is open to examination.

"Light" records the detection and exposure of three professed mediums in the United States.

Prof. Borggreve ("Forst. Blätter") denies that woods produce an increased quantity of rainfall.

M. Van Hasselt laid before the Academy of Sciences of Amsterdam the skin of a cobra, from Sumatra, of the unusual length of 3·9 metres (12½ feet). It agreed with a second specimen in the author's collection which he has already described as *Naja ingens*.

M. Poulet ("Comptes Rendus") seeks to show that the acidity of the gastric juice in man is hippuric acid.

MM. E. Perrier and J. Poirier take exception to the views of Prof. Jourdain on the reproductive organs of the sea-stars as given in the "Comptes Rendus." They hold that the circular dorsal canal and the hydrophoric pouch have no connection with the excretory apparatus of the genital glands.

According to the "Archiv. d. Pharm." the different kinds of aconitine nitrate met with in commerce vary greatly in poisonous power. That of Petit is 8 times stronger than Merck's, and 170 times stronger than Friedländer's.

Dr. J. D. Thomas, on behalf of the Colonial Governments of Adelaide and Victoria, is engaged with researches to prove that the prevalence of hydatid disease in man and in the lower animals is proportionate to the number of dogs kept in a community.

According to Prof. Jules Gaudard (Institution of Civil Engineers) the force of waves, beating against exposed structures, may reach a pressure of 6000 lbs. per square foot, The maximum wind-pressure registered in England has been 71 lbs. per square foot.

Mr. E. Wadsworth considers the copper-bearing rocks of Lake Superior as of Potsdam age.

M. P. Bert ("Comptes Rendus") shows that the blood of animals originally belonging to, or acclimatised in, high mountain regions, has a much greater capacity of absorbing oxygen than the blood of the same or of analogous species living at lower altitudes.

The "Popular Science Review" sharply criticises Prof. Goldwin Smith's attack upon Mr. Herbert Spencer's ethical system, and makes some good points. But no one seriously inquires whether Evolutionism fairly admits of the conclusions deduced from it by some of our "advanced" thinkers.

According to MM. Heckel and Schlagdenhauffen ("Comptes Rendus") the kola-nut contains more caffeine than coffee, along with theobromine and grape-sugar. It is rich in starch, but poor in fatty matters.

With reference to the supposed protection against sewer gases offered by water-traps, the "Medical Press and Circular" reminds scientific men that the water absorbs the sewer gases in the soil-pipe, and then gives them off into the house.

Mr. E. Ray Lankester, F.R.S., &c., has been definitely appointed to the chair of Natural History in the University of Edinburgh, and has since given in his resignation.

We learn that at a complimentary dinner given at Halifax to Mr. T. Dolan, F.R.C.S., of that town, it was proposed to found a local Medico-Chirurgical Society and a medical library in connection with the Infirmary.

A mixture or alleged compound of glycerine and boracic acid is being put forward as an agent for the preservation of articles

of food. Considering that boron is not an element naturally occurring in animals or vegetables, we think that its use will require to be cautiously watched.

Dr. Gordon ("Scottish Naturalist") gives an account of a fishing frog (*Lophius piscatorius*) being found dead with a recent specimen of the great black-backed gull (*Larus marinus*) in its stomach. He suspects that the frog died from having swallowed the bird.

The Senate of the University of Edinburgh has decided to confer the honorary degree of LL.D. upon Dr. R. Angus Smith, F.R.S., and Dr. John Simon, F.R.S.

In the "Medical Press and Circular" Dr. Mason, of Hull, is reported as declaring that zymotic diseases had increased since the introduction of the present educational system. This is decidedly probable.

M. J. Chappuis ("Comptes Rendus") has examined the absorption spectrum of pernitric acid. It is characterised by fine black lines, very distinct, and totally unlike the broad, grey, somewhat indefinite bands of ozone by which pernitric acid is always more or less accompanied.

M. P. Bert has been elected a member of the Academy of Sciences (Section of Medicine and Surgery) *vice* M. Bouilland, deceased. M. Brown-Sequard obtained merely one vote!

According to M. J. Tayon ("Comptes Rendus") African asses are able to resist splenic fever. Repeated inoculations produced merely a local tumour, which remained for about a week, whilst the general health of the animals was not affected.

It is interesting to find that a "lunatic," claiming, like Guiteau, a divine mission, has shot Dr. J. J. Gray, who was one of the witnesses called to rebut the plea of insanity raised on behalf of Guiteau.

Dr. Sozinsky ("Medical and Surgical Reporter") gives as the normal stature of a male child, at the end of the first year, 30 inches in height, and 25 lbs. in weight.

The Fungi which appear in decaying articles of food, though usually harmless, are occasionally, and under unknown conditions, accompanied by other low organisms of a very deleterious character.

M. G. de Saporta ("Comptes Rendus") has discovered, in the Middle Permian beds of Jelovick (Russia), impressions of a curious species of Ginkgo, a form represented in our days by a single species, and not traced hitherto farther back than the Rhætian.

Dr. Koen has proved, in a memoir read before the Physiological Society of Berlin, that tuberculosis is due to a special microbion—a *Bacillus* not unlike that of *Lepra*.

The "Medical and Surgical Reporter" (Philadelphia) contends, in an able editorial, that much mischief is done by sending children to school too early, and that the portion of life prior to puberty should be mainly devoted to physical development.

It appears that the Government intends to appoint two official toxicologists to conduct the analysis of the bodies of persons whose death seems to necessitate a special investigation. The nomination of these analysts will be entrusted to the Presidents of the Colleges of Physicians and Surgeons.

The "American Naturalist" says:—"On this point (the origin of mimetic coloration) the Darwinian is on the same footing as the old time Creationist. The latter says God made the variations, and the Darwinian says that they came by chance. Between these positions Science can perceive nothing to choose.

According to the same journal wild geese have become a pest in the San Joaquin Valley, in California, and are committing great depredations.

Dr. J. A. Osborne proves the extensive occurrence of parthenogenesis in *Gastrophysa raphani*.

By the will of the late M. Jules Putzeys his valuable collection of Coleoptera has become the property of the Entomological Society of Belgium.—*American Naturalist*.

Dr. C. A. Gordon ("Medical Press and Circular"), in an interesting paper on "Climate in Relation to Organic Nature." whilst admitting the injury occasioned to climate by the removal of forests, stated that neither Conifers nor the Eucalyptus absolutely abolish malarial disease and cholera.

Dr. Connstein, of Heidelberg, is of opinion that in women, as in other female mammals, impregnation takes place principally at some particular season of the year.

Dr. A. S. Packard, jun. ("American Naturalist"), criticises Prof. E. Ray Lankester's memoir "Limulus an Arachnid" ("Quarterly Journal Microsc. Science"), and contends that the species in question is essentially Crustacean.

We regret to learn that M. Eugene Boutney, a zealous investigator of the ptomaines, has recently died of carbuncle due to absorption of some of the very poison in question.

One Mr. Bergh has recently come forward as a furious Anti-Vaccinationist, in the February number of the "North American Review."

A correspondent of "Light" suggests that it might be well to discourage *post-mortem* examination till the body has been cold at least three or four days: for if the Spirit should be capable of feeling the terrors of the surgical operation, it must be a trial of unequalled horror. Surely such a delay must in many cases be in danger of frustrating the very objects for which *post-mortem* examinations are undertaken.

The Report of the Mining Surveyors and Registrars of Victoria gives the proportions of gold from quartz rock obtained at different depths. The richness of the mineral stands in no perceptible relation to the depth at which it lies. The richest sample (10 ozs. 9 dwts. 12 grs.) was got at the depth of 840 feet. One of the next richest (3 ozs. 10 dwts. 12 grs.) at 130 feet; and the poorest of all (16 grs.) at 400 feet.

We regret to learn the death of an occasional contributor to our pages, Mr. J. Hepburn Davidson.

The German Congress of Naturalists and Physicians will meet this year on September 17th.

M. E. Brandt has laid before the Academy of Sciences an account of researches on the nervous system of certain Dipterous larvæ of the families Leptidæ, Bibionidæ, Xylophagidæ, Therevidæ, and Dolochopididæ. The larvæ of the Leptidæ have thirteen ganglia, *i.e.*, two cephalic, three thoracic, and eight abdominal, all connected by double nerves as in the adult insects. In all other Diptera the ganglia are united by single connections. The larvæ of the Bibionidæ, Xylophagidæ, and Therevidæ, as well as the Asilidæ, have the same respective numbers of ganglia with simple connections. The adults have merely two thoracic ganglia, the anterior one being formed from the two first in the larva, whilst the posterior ganglion is formed from the third of those of the larva. In the larvæ of the Dolichopididæ there are still the same number of ganglia, which in the adult are reduced to four—two cephalic and two thoracic. The larvæ of the Fungicolæ have sometimes thirteen, sometimes twelve ganglia, the two posterior in the abdomen merging into one, as in Rhyphus. The larvæ of the Tabanidæ have only seven distinct ganglia. M. J. Künckel d'Herculais maintains that they have merely two. Is this a difference of species or of age? The nervous system of the larvæ of the Tabanidæ forms an intermediate link between the Muscidæ and the Nemoceridæ.